HOLNAM

Devil's Slide Quarry
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Mr. D. Wayne Hedburg, Permit Supervisor
Utah Department of Natural Resources
Division of Gas, Oil and Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84114-5801

Re: Application to Revise Large Mining Operation Permit, Holnam, Inc. Devil's Slide Mine, M/029/001, Morgan County Utah

Dear Mr. Hedburg:

Please find attached for your review, our application for permit to revise our Devil's Slide Mine reclamation plan with maps and attachments. If there any questions or you need further information, please contact Ken George (801 829-2153) or Kevin Ovard (801 829 2122) at the Devil's Slide Plant.

Thank you for your attention in this matter.

Sincerely

Ken

Ken George
Quarry Coordinator
Devil's Slide Quarry

KG/kg

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JUN 07 2001

DIVISION OF
OIL, GAS AND MINING

May 17, 2001

State of Utah, Department of Natural Resources
Division of Oil, Gas, and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City , Utah 84114

RE: DOGM Questions and Review of Application to Revise Large Mining Operations/Permit Overburden Dump, Devil's Slide Mine, M/029/001 Devil's Slide Plant - Morgan County, Utah

Gentlemen:

Holnam has submitted a Notice of Intention to Revise Mining Operations for permitting an Overburden Dump at the Devil's Slide Mine in Morgan County, Utah. The State of Utah, Division of Oil, Gas and Mining (DOGM) has reviewed this Notice of Intention. On Wednesday, January 24, 2001, a meeting (and conference call) to discuss questions related to the DOGM's review was attended by representatives from Holnam, DOGM and Harding ESE (Harding). The purpose of this meeting was to discuss the intent and understanding of the questions regarding the review of application to revise the large mining operations/permit for the overburden dump. The purpose of this letter is to address the issues pertaining to the overburden dump and establish a schedule for completion of tasks related to revision/update of mine permit M/029/001. Two outstanding items that are not addressed in this letter include the proposed Overburden Dump Soil and Vegetation surveys. Holnam will complete the soil and vegetation surveys in the summer of 2001. The DOGM questions are as follows:

R647-4-104 - Filing Requirements and Review Procedures

DOGM: *The permit for the Devils Slide Quarry was issued on December 3, 1987, since that time the bond amount has only been escalated to reflect inflation. Normally the Division reviews a large mine permit every 5 years to address changes in the operation, which would necessitate a change to the reclamation surety amount. This notice has been categorized as a permit revision to the original approved large mine notice. A number of technical deficiencies have been identified. When these deficiencies have been satisfied, a tentative approval finding will be made by the Division. A formal Notice of Tentative Approval publications will then be published by the Division, which begins a 30-day public comment period.*

Holnam: The Overburden Dump Application to Revise Large Mining Operations/Permit is submitted as a separate stand-alone document/permit. This permit letter addendum will respond to issues directly related to the Overburden Dump permit. Revisions to the December 3, 1987 mine permit M/029/001 will be handled as a separate issue from the Overburden Dump permit. Revisions to the mine permit M/029/001 will be completed in the Fall of 2001.

R647-4-105 - Maps, Drawings & Photographs

105.1 Topographic base map, boundaries, pre-act disturbance

DOGM: *The 7.5 minute quadrangle map included with the application is insufficient. The scale is too small to discern features within the area of the mine. Please submit a map with a scale of 1"=500' or larger.*

Holnam: A new USGS Topographic base map and a more detailed topographic base map of the Devils Slide Plant and Quarry is submitted under the Figures section of this permit letter addendum. The USGS topographic map has a graphical scale that reflects that USGS quad map software. The more detailed topographic base map of the Devils Slide Plant and Quarry is set with a scale of 1" = 400'.

105.3 Drawings of Cross Sections (slopes, roads, pads, etc.)

DOGM: *The Plan view drawing in the recent submittal is unclear as to what areas will be filled in with mining waste. The cross sections show more area will be filled that what is shaded on the plan view drawing. Please revise these drawings, to more clearly identify the areas to be affected.*

Holnam: Plan view and cross sections have been updated and shading has been applied to indicate areas to be filled with mining waste. Under the Figures section, see Map dcc-1338-97 - Devil's Slide Mining Permit (showing plan view of Overburden Dump) and Map DCC-1702 - Cross Sections of the Overburden Dump.

R647-4-106 - Operation Plan

106.2 Type of operations conducted, mining method, processing etc.

DOGM: *The submission states that slopes will be spread and contoured is ambiguous. Please clarify this statement by describing which slopes will be affected and how they will be contoured along with slope angles, etc., needed to complete this task.*

Holnam: This statement will be addressed by demonstrating through the use of computer modeling (GEOSLOPE software) that the slopes, set at 2.5:1 or 3:1, will have a factor of safety of 1.2 to 1.5, as required by the DOGM. A discussion on the technical issues of the computer software, including a recommendation section regarding contouring, slope angles and at what slope angles will also be submitted for this question.

Response: A slope stability analysis was conducted for the proposed Overburden Dump. For this analysis, Holnam reviewed three possible "re-contoured" slope gradients under high and low groundwater conditions. The three slope gradients examined include a 2:1, 2.5:1, and 3:1 Horizontal to Vertical (H:V) slopes. The slope stability evaluation examines the slopes under static loading conditions using a "grid & radius" failure search program, which defines a rotational slump failure. Soil strength information (internal friction angle, cohesion and unit density) has not been developed for this site through drilling and material testing. Subsequently Holnam is using historical data from material testing of the limestone at the Devil's Slide mine in addition to published literature regarding soil & rock strength based on similar soil types. Published references have been submitted for review in subsequent paragraphs under this question. In the following Holnam's approach to calculating the slope stability analysis is presented.

The slope stability analyses were performed on profiles A-A', and B-B' (see Map DCC-1702 - Holnam Cross Sections of the Overburden Dump, Scale under the figures section). Profile A-A' is located down the center of Quarry Hollow, which includes some of the deepest portions of overburden dump. The second profile, B-B' is located through the steepest portion of the Overburden Dump that extends to the west into Cottonwood Canyon. Both profiles encompass the total length and depth of the proposed overburden dump. The Overburden Dump slope stability analysis was completed by utilizing the SLOPE/W Version 3 (1995) computer program GEO-SLOPE© International Ltd., Calgary, Alberta, Canada, to compute factors of safety against failure. The factor of safety is the ratio of the forces resisting the slope movement to the forces, which cause the slope to fail. The resisting forces are determined by the shear strength of the overburden dump soils to resist failure along a specific surface. The forces which tend to cause failure include, but are not limited to: (a) the angle of the slope; (b) the location of existing roads and drainage ditches in relation to the slope; (c) pore pressure or water table acting on the failure plane; and (d) the characteristics of the soil placed in the overburden dump. A factor of safety of 1.0 implies that the slope is marginally stable for cross-section profiles, overburden soil material strengths, groundwater, and slope gradient conditions. Surface water was not evident during the calendar year 2000 field investigation, except in a shallow depression used for watering cattle.

Parameter Selection

A description of the criteria used in the GEO-SLOPE© program to evaluate the factors of safety for slope stability failure on Profiles A-A' and B-B' of the Overburden Dump is as follows:

<u>Slope Geometry</u>: The stability analysis incorporated three different slope profile gradients. The slope profile gradients examined by the GEO-SLOPE© program are 2:1, 2.5:1 and 3:1 (H:V). Both profiles (A-A' and B-B'), were modeled with the three slope gradients. Geometrically, both profiles encompass the deepest and steepest portions of the proposed Overburden Dump, respectively.

<u>Groundwater</u>: Depth to groundwater has not been determined for this site. However, in an alpine environment, groundwater is expected to be high in the late winter/early spring and low to non-existent in the summer and fall. It is anticipated that groundwater will follow the natural flow lines of the Quarry Hollow and Cottonwood Canyon topography. Groundwater is expected to be absent at higher elevations (unless perched), and flow toward the naturally occurring drainage channels at lower elevations. For this stability modeling effort, Holnam assumed both a high groundwater table and a

very low groundwater table. Two high groundwater table scenarios are possible in the proposed Overburden Dump. The first scenario represents a perched aquifer from stratification of fine to coarse sediments in the Overburden Dump. The second scenario represents a free draining Overburden Dump that has high saturation (and retention) from snow melt or heavy rainfall. For this environment, a low groundwater table will probably exist. Hydrologically, the low groundwater table was incorporated above and along the bedrock/colluvial soil contact.

<u>Soil Strength Properties</u>: Three soil types were modeled in this analysis. The soil types included an overburden soil, colluvial clay and limestone/siltstone bedrock. The Overburden Dump and the colluvial soil strength parameters are based on published information of similar soils and from historical data from mining operations at Devil's Slide. Colluvial soil strength values are based on textbook parameters as determined by Harding ESE using the Unified Soil Classification System. The bedrock strength value is estimated from a mining industry reference (Hoek and Bray, 1994), the soil parameters are as follows:

- Overburden Dump soil matrix: Low plastic clay, silts mixed with limestone and sandstone gravel and cobble sized debris, cohesion 50.0 psf, internal friction angle 35.0 degrees, moist unit weight 110.0 pcf. In our model, the depth of the overburden soils is based on the cross section profiles in Map DCC-1702.

- Colluvial soils: Clay, silts and gravel's, cohesion 600.0 psf, internal friction angle 26.0 degrees, moist unit weight 100.0 pcf, saturated unit weight 116.0 pcf. In our model, the thickness of the colluvial soil has been estimated. For our purposes, colluvial soil(s) have been modeled thicker than what may be expected in the field. A thicker colluvial soil will have a lower factor of safety, as the rotation slump will extend into this soil horizon.

- Bedrock: Limestone with some siltstone layering: Bedrock is below the colluvial soils, cohesion 20000.0 psf, internal friction angle 35.0 degrees, moist unit weight 130.0 pcf. For our purpose bedrock is modeled relatively deep within the profiles. Typically landslides do not occur in bedrock, thus too truly represent the overburden dump soil's landslide possibility, bedrock exposure was minimized.

The GEO-SLOPE© computer program uses the ordinary, Janbu, Bishop, and Spencer method of slices to determine failure. It compares the forces resisting slope failure to the forces, which cause slope failure along a specified failure surface. The analysis utilizes a limit equilibrium procedure to calculate the factor of safety against failure. The input information for the analyses includes, but is not limited to, slope geometry, groundwater conditions, and soil strength loading conditions. A complete set of graphical computer output files have been attached to this permit letter addendum under Appendix A. The GEO-SLOPE© graphical computer files are submitted as pairs. The first file shows the location of the potential rotational failure and the corresponding lowest factor of safety for this potential rotational failure plane. The second file shows the grid and radius search pattern, utilized to find the lowest factor of safety for that particular model/analysis.

Slope Stability Results

The results of the Overburden Dump slope stability analyses are outlined in the following table:

Table One: Factors of Safety for Overburden Dump

Profile	Slope Gradient (H:V)	Perched Groundwater Table	No Groundwater Table
A-A'	2:1	1.41	2.04
	2.5:1	1.42	2.08
	3:1	1.42	2.13
B-B'	2:1	1.39	1.96
	2.5:1	1.40	1.98
	3:1	1.99	1.99

From this stability analysis some evident patterns have been determined. The first pattern is that the factors of safety are lower in the models having a high groundwater table, alternatively the factors of safety are higher when the groundwater is low. The lower factors of safety in the high groundwater model can be expected, as the groundwater provides the necessary lubrication for a landslide to occur. The second pattern is that the factors of safety increase as the slope gradient gets flatter from the 2:1 (H:V) to the 3:1 (H:V) slope. A less obvious pattern in the graphical files indicates that, although a grid and radius failure search pattern was used for the entire slope, landslides tend to occur in the bottom third of the slopes. This can be expected as groundwater will flow to the toe and the weight of the higher elevation soils will push down on the lower soil layers to create a possible landslide toe failure.

General Observations: The proposed Overburden Dump slopes will have a sufficient factor of safety at a 2:1 Horizontal to Vertical slope (factor of safety falls within the range specified by the DOGM), a 2.5:1 or 3:1 is more practical from a construction and reclamation purpose. All outside slopes of the Overburden Dump will be graded and contoured so as to minimize soil erosion and enhance long-term plant growth reclamation. A more comphrensive discussion on contouring, surface roughness and slope breaks is discussed in question R647-4-109.4 Impact Assessment.

REFERENCES:

1. American Association of State Highways and Transportation Officials, 1996. "Standard Specifications for Highway Bridges", Sixteenth Edition, Figure 1-5, Map of Horizontal Acceleration.

2. Michael R. Lindeburg, 1992, "Civil Engineering Reference Manual", Sixth Edition, Chapter 9 Soil Mechanics, Professional Publications Inc.

3. Spangler Merlin G, and Handy Richard, L., 1982. "Soil Engineering", Fourth Edition, Harper Collins Publisher, Figure 11.14.

4. E. Hoek & J.W. Bray, 1994, "Rock Slope Engineering", Revised Third Edition, Institution of Mining and Metallurgy, University Press, Cambridge, Pg. 23.

5. State of Utah, Revised as of November 1, 1996, "R645 - Coal Mining Rules", Department of Natural Resources, Division of Oil, Gas and Mining, Salt Lake City, Utah, R645-301-500. Coal Mine Permitting: Engineering. Pgs. 63 - 65.

6. State of Utah, Department of Natural Resources, Revised May 5, 1999, "R647.1 through R647-5", Division of Oil, Gas, and Mining, Salt Lake City, Utah, Minerals Reclamation Program.

106.3 Estimated acreage disturbed, reclaimed, annually.

DOGM: *The disturbed acreage to be bonded and reclaimed in this revision will need to be the entire affected area of (169.8 + 14.7) 184.5 acres. Although 14.7 acres of this revision falls into the affected area of Holnam's existing permit area, the reclamation of this acreage is not presently covered by the existing bond. The surety for this revision will need to include the reclamation of this 14.6 acre disturbance.*

Holnam: Holnam has developed a more detailed map of the Overburden Dump area. Changes in the acreage have been accounted for in the surety calculation recheck. The surety calculation will include the entire *(169.8 + 14.7) 184.5* acres as proposed for the Overburden Dumps. The 14.7 acres that follows within the original mine permit will also include a surety calculation recheck.

Response: The new revegetation calculation is submitted as Appendix A. Assumptions used for determining the surety calculations are as follows:

1) Details such as vegetation species were obtained from DOGM. No fertilizer mixture or application rate was provided by the agency; thus no fertilizer costs have been included in the cost estimate. Assumptions used to complete the cost estimate included the use of a rangeland drill to plant the seed mixture. Holnam has committed to completing vegetation and soil surveys for the proposed Overburden Dump in the summer of 2001. The seeding requirements (as outlined in the surety calculation table section) and fertilizer application rate could change as a result of these surveys.

2) The method used for seeding Test Plot #2 was hydroseeding. (While this is appropriate for a small test area, it may be more cost effective to use standard agricultural equipment to seed a much larger area with longer slopes.)
3) The disturbance/reclamation acreage figure of 184.5 acres was obtained from Holnam's plan map of the Devil's Slide area. It reflects the area labeled "Limit of Proposed Dump Overburden." This area includes ancillary roads, haul road, topsoil piles, and increased disturbance footprint due to reclamation activities.

106.4 Existing soil types, location, amount

DOGM: *The submission states that, "No suitable soil material is projected for salvage from the proposed overburden dump areas." However, soil descriptions submitted with the original NOI as well as the photos submitted with the latest revision suggest that there are suitable soil materials that could be salvaged.*

Before any disturbance will be allowed in the proposed waste dump area, the amount of suitable material will need to be verified and plans to salvage and stockpile all suitable material will need to be submitted and approved. Samples of the soil material will need to be sent to a soils lab for analysis to determine suitability. The analysis will need to include at a minimum, pH, % organic matter, electrical conductivity (EC), SAR, Cation Exchange Capacity (CEC), total nitrogen, nitrate nitrogen, phosphorus (AS P2O3) and potassium (AS K2O).

A site visit after spring snowmelt will need to be arranged to accomplish this. These plans must include the volume of material to be salvaged, the location and size of all soil material stockpiles, how the soil material will be protected so that it is available for reclamation and how soil material will be redeposited for reclamation (including depth of replacement). If there are areas where the soil materials are not suitable, or could reasonably be amended so that they were suitable, a variance will need to be requested and approved to not salvage soil from these areas. The area for which the variance is requested will also need to be clearly labeled and outlined on a reclamation treatment map.

Holnam: A soil survey of the proposed overburden dump will be completed in the summer of 2001. The soil survey will describe the volume of material to be salvaged, the location and size of all soil material stockpiles, how the soil material will be protected so that it is available for reclamation and how soil material will be redeposited for reclamation (including depth of replacement). In the interim, Holnam requests that stripping and initial development of the overburden dump can start before the soil survey is completed. Holnam understands that DOGM may want to be present on site during the initial start of the soil survey. Holnam will also submit a soil-stripping map indicating what sections of land will be stripped for the overburden dump, and in what sequence. The soil-stripping map will be presented on the revised site map. Supplementary language describing the soil stripping will accompany the new map. The soil survey will be submitted as an addendum in June or July to the overburden dump permit.

106.5 Plan for protecting & redepositing soils

DOGM: *Please refer to comments made under R647-4-106.5*

Holnam: The soil survey under question 106.4 will include the location(s) of topsoil pile and methods for protecting against erosion.

106.6 Existing vegetation - Species and amount

DOGM: *The submission refers to the vegetation survey in Appendix H of the original NOI to describe the vegetation that will be affected by the new waste dump. However, photos provided of the proposed waste dump area do not show the same vegetation communities as described in Appendix H. Therefore, it will be necessary to have a vegetation survey completed in the vegetation types that will be affected by the proposed waste dump. The survey needs to include the plant species present and the percent of ground covered by the aerial projection of the vegetation. The survey should be planned for June - July/2001.*

Holnam: A vegetation survey will be completed in June or July of 2001. The vegetation survey will be conducted for the proposed overburden dump area. The vegetation survey will provide a baseline inventory, including the percentage of canopy cover. The vegetation survey will be submitted as an addendum to the Overburden Dump permit. In the interim, Holnam would like to start stripping and placement of overburden soils prior to the start of the vegetation survey. The vegetation survey will provide an estimate of vegetation type and amount in areas that have been stripped and prepared for deposit of overburden soils.

106.9 Location & size of ore, waste, tailings, ponds

DOGM: *Please show the location of the stock water pond as shown in the photograph on the appropriate drawing/map.*

Holnam: This will be provided in the new site Map DCC-1597 - Holnam Topography Devil's Slide Plant & Quarry Area, Scale 1" = 400' in the Figures section.

R647-4-107 - Operating Practices

107.2 Drainages to minimize damage

DOGM: *No plans are given or designs included for drainage channels, although it appears that the runoff occurs in response to snow melt and severe thunder storms and is ephemeral in nature. What downstream controls will exist in Quarry Hollow or Cottonwood Canyon to prevent the down stream migration of sediments during construction.*

Holnam: Under the first part of this question plans and designs for the drainage channels for runoff in response to snow melt and severe thunder storms for Quarry Hollow and Cottonwood Canyon have been addressed under R647-4-111 – Reclamation Practices Question 111.2 –Reclamation of natural channels. Supporting text maps, and tables have been attached to this document. Downstream controls to minimize the migration of sediments during construction will be controlled through the field implementation of various Best Management Practices (BMP's). There are various published and non published BMP's for controlling runoff and migration of sediment. Some appropriate BMP's that could be utilized at the Overburden Dump are submitted under Appendix B of this letter. The various methods of BMP's in Appendix B include runoff interception, water resource protection, gravel filter berms, straw bale barriers, dugout ditch basins, sediment control fences and vegetative buffer strips. Holnam reserves the right to use any or all of these BMP methods to control runoff and to implement downstream control measures that will limit the migration of sediments during construction and the operation life of the Overburden Dump. In previous published Holnam documents, we have used the following BMP's for control. The quarry strip material in the Bone Yard and Quarry Hollow is placed on the natural angle of repose (approximately 35 degrees). This has proven to be sufficient to prevent any washing due to the amount of rock and the wide gradation range providing a very stable slope. Additional stabilization is not required prior to reclamation due to the integrity of existing slopes and no evidence of washing or erosion. The catch basins and emergency dams as discussed in Section III.B. (1987 Reclamation plan) are a major part of sediment control. The road berms, as required by MSHA safety regulations, also direct minimal road runoff to a catch basin. Representatives of DOGM have visited the quarry and given recommendations on additions and improvements to the berm system. These suggestions are being implemented. The existing roads have no culverts, cross-drains, or ditches. Runoff quantities have never occurred to cause any drainage problems. The roads are all built to MSHA regulations and well maintained by quarry operations.

107.3 Erosion control & sediment control

DOGM: *Please update your mine plan to show location of all sediment and erosion control structures on an appropriately scaled surface facilities map.*

Holnam: The new site facilities map will provide locations of current sediment and erosion control structures and will be appropriately scaled to the surface facilities map for this permit letter addendum. Actual erosion control features (BMP's) for the Overburden Dump will be placed in accordance to field conditions (i.e. fiel fitted based on need). Erosion control structures for the Overburden Dump will be temporary in nature and will evolve as the dump evolves. Typical BMP's will be consistent to those presented in Appendix B.

107.6 Suitable soils removed and stored.

DOGM: *Will the waste dump be constructed such that certain portions will be completed and could therefore be reclaimed prior to the total dump being completed.*

Holnam: Yes, the overburden dump can be staged such that reclamation may be able to be initiated in stages. However, Holnam reserves comment on this subject until an Overburden Dump operation life and soil-stripping schedule is determined. Holnam reserves the right to submit a permit letter addendum for staging the reclamation on the Overburden Dump after certain initial portions of have been completed/constructed.

R647-4-109 - Impact Assessment

109.3 Impacts on existing soils resources.

DOGM: *This section has not been addressed. Please refer to comments made under R647-4-106.5*

Holnam: Holnam has committed to conducting a soil survey on the proposed dump area in 2001. Please refer to the response to question 106.5.

109.4 Slope stability, erosion control, air quality, safety

DOGM: *It is important to provide a demonstration of onsite erosional stability through the application of current practices of surface roughness, slope breaks, etc. Please provide this demonstration.*

Holnam: Erosion control measures currently utilized at the Devils Slide mine site will be constructed on the proposed Overburden Dump (see Section 107.2 as to various methods of BMP's). These erosion control measures have successfully minimized erosion from a recent 100-year storm event cycle.

The most significant consideration in analyzing the quarry drainage is that no significant runoff has ever occurred during the life of the mine. For example, on February 17, 1986 there was 1.82 inches of rainfall. The storm lasted for several days, and in addition to the rainfall, the entire snowpack in the quarry area melted during this storm and added to the runoff. Morgan county received $400,000 damage to public facilities due to flooding and was declared a State and National Disaster area. The ten year storm of 1.4 inches and the theoretical runoff for the two drainages in the quarry area is given in the "Drainage Calculation". This amount of runoff did not occur at anytime during or after the storm. The Bone Yard drainage had standing water (< 1 inch) on the loading floors and flat areas during the worst of the storm. The emergency dike (catch basin #6) contained less that .02 acre feet of water (approximately 400 sq. ft. of surface area). There was no significant flow and the standing water on the flat areas was absorbed in a very short time after the rain ceased.

The Quarry Hollow drainage also showed a very high percolation rate. Above the quarry operation there occurred a small channel flow that came into the "french drain". After that point no surface flow occurred and it was evident that the flow was underground in the "french drain". At the bottom of Quarry Hollow on the haul road and the sandstone loading floor there was standing water (< 1 inch) during the worst of the storm. It was possible at this time that some of the flow entering the "french drain" was surfacing next to the haul road. This was very slight, if at all, and difficult to determine amounts due to the standing water on the road. The theoretical flow as calculated did not occur and as stated, no flow occurred in Quarry Hollow in the quarry area.

On August 20, 1986, there was another heavy storm that confirmed the results of the February storm. A total of 2.2 inches of rain fell and the runoff conditions were nearly identical to the earlier storm with the exception that no water surfaced at the bottom of the Quarry Hollow "french drain" and no water was retained by the emergency dike in the Bone Yard drainage. This could be due to the different soil condition than during the February storm when most of the ground was frozen. (1987 reclamation plan)

Response: Published and unpublished standards for slope/surface roughness erosion control have been reviewed. A detailed drawing with supporting text for slope roughing of the Overburden Slopes has been provided (Appendix B). Overall stability of the Overburden Dump is discussed in Section 106.2, Slopes breaks and erosional stability addressed in Appendix A of this letter.

R647-4-110 - Reclamation Plan

110.5 Revegetation planting program

DOGM: *The plant species proposed for revegetation in the original NOI are appropriate for this amendment. However, there are additional species that should be added to improve the reclaimed areas for the approved post mining land use (wildlife habitat and grazing). Also, the original proposed seeding rates are considered excessive. Attached to this review is a seed mix that includes the recommended changes. If this mix is acceptable, please acknowledge your acceptance in writing. The original NOI calls for the use of approximately 140 lbs./acre of fertilizer and the use of 1500 lbs. of mulch. This may not be necessary. Also, 6 inches of soil material over the waste dump may or may not be adequate. A final decision cannot be made until the soil resources information (See R647-4-106.5) is resolved.*

Holnam: Proposed changes to the revegetation seeding and amendment rates will be submitted in a letter addendum for the Overburden Dump revision after the Vegetation Survey. Changes to the revegetation seed mix and fertilizer application rate will be a function of the vegetation and soil surveys proposed for completion in the summer of 2001.

R647-4-111 - Reclamation Practices

111.1 Public safety & welfare - Posting warning signs

DOGM: *Please post appropriate signs to warn the public of the hazards that will be encountered within the affected area. These signs should be posted at entrances to the permitted areas.*

Holnam: Posting of warning signs for purpose of public safety and welfare warning will be completed by Holnam. Signs will be placed in accordance to MSHA standards.

111.2 Reclamation of natural channels

DOGM: *Nothing has been provided in the plans regarding location and sizing of reclaimed channels other than a statement that the drainage will be routed off the dump face. Please provide the necessary detail to describe how drainage will be routed off the dump face, i.e. location of channel and sizing of the channel handle the expected flows. This detail should be provide an estimate of the watershed area contributing to this reclaimed drainage.*

Holnam: Currently French drains are being utilized for routing water on the mine site. Holnam will provide appropriate examples, pictures or figures and support text for this question using current mine practices as referenced. The size and expected runoff from the watershed will be calculated and any channels will be sized as needed to control erosion.

Hydrology Response:

A drainage area delineation of the Holnam dump expansion at the Devil's Slide Mine in Utah was conducted using a USGS quadrangle map. Two small drainage basins were identified that affect the proposed dump expansion (Drainage Area Map R647-4-111.2a under Appendix C). Existing plans call for a sloped fill area at the northeastern perimeter of the dump expansion that will create a desilting basin. As a result, and because of the different cover and slopes between the non-disturbed upper drainage area and the dump, the eastern drainage area was split into two sub-drainages for design purposes. They are DA-1N (northern section with native slopes and vegetation) and DA-1S (mine dump expansion).

Surface drainage is well developed in much of the area. Following are the series type and a brief hydrologic description of the soils identified on the mine property:

- St. Marys (gravelly loam) - Well drained with medium to rapid runoff and moderate to moderately rapid permeability.
- Hoskin (cobbly loam)- Well drained or somewhat excessive drained with medium to rapid runoff and moderate to moderately rapid permeability.
- Henefer (silt loam) - Well drained with medium to slow runoff and slow permeability.
- Kilfoil (loam)- Well drained with medium runoff and moderate permeability above the bedrock.

Average annual precipitation for the area is 24 to 28 inches per year (NCRS Utah Annual Precipitation, 1961 - 1990). Design storm rainfall intensities were taken from Utah Isopluvial (hyetograph) maps, NOAA Atlas 2, Volume VI (Appendix C). Runoff was calculated using SCS Type II method. Hydrologic soil cover classes (National Engineering Handbook, Handbook for Environmental

Engineering and NRCS maps) were used to determine curve numbers, and these were assigned to each of the drainage areas. Peak flow, runoff depths and volumes were calculated for four 24-hour storm events (2, 10, 50 and 100 year). This information is presented in the Dump Expansion Hydraulic Summary table.

Ditches and Desilting Basins (Ditches and Basins Map R647-4-111.2b in Appendix C)

Drainage Area 1: Runoff from drainage area DA-1N (north) will report to an upper desilting basin at a sloped fill area being constructed at the northeastern perimeter of the dump expansion. This basin will be sized to contain runoff from the 10-year event. From this point, an overflow ditch will be constructed and maintained on the eastern edge of drainage area DA-1S (south) to transport the combined flows of the two drainage areas. The ditch is divided into two segments for design purposes (see Ditches and Basins Map):

- Ditch Segment 1: "V" notch or equivalent 2 feet deep with 3:1 side-slopes. Armor with 4 inch (median diameter) riprap a minimum of 1 foot deep (below flow line) to reduce velocity and limit scour. .
- Ditch Segment 2: "V" notch or equivalent 1.0 feet deep with 3:1 side-slopes. Armor with 40 inch (median diameter) riprap a minimum of six feet deep (below flow line) to reduce velocity and limit scour. See Design Summary and Pipe Option section.

Construction of a lower basin at the southern (down-gradient) end of the dump expansion will desilt the dump runoff and overflow from the upper basin.

Drainage Area 2: This drainage area consists almost entirely of dump expansion. Assuming the expansion will be level across the top with a uniform sloped face, no ditches will be necessary to prevent erosion; however, the entire topsoil area will be cross-ripped (perpendicular to the slope) and seeded. A temporary desilting basin will be constructed and maintained at the bottom of the west slope until vegetation is established. An optional swale or swales may be constructed between the toe of the dump and the west-desilting basin to direct flow in a northerly direction. This will reduce velocities and serve as a pre-desilting basin should runoff cut a path through the cross-ripped area. The swale will also serve as a rolling rock barrier at the toe of the western dump.

Channels and desilting basins have been designed to contain and transport runoff for a 10-year storm event. Desilting basins will be monitored on a regular basis to check for breaches or sediment deposits. Removal of deposits and repairs will be made as necessary. Design dimensions are included with the attached tables.

Design Summary and Pipe Option

Because of the steep slope and anticipated high runoff velocities of ditch segment 2 (DA-1S (sloped fill), Map R647-4-111.2b), the size and placement of riprap may not be practical. An alternative will be placement of HDPE pipe from the upper desilting basin to a point near the plant facility prior to placement of waste rock. Piping runoff under the dumps will require the construction of a concrete stilling box with removable weir boards in the upper desilting basin and an energy dissipater at the inlet to the lower basin.

The overflow ditch (segments 1 and 2) will still be constructed, but riprap and maintenance requirements will be reduced. Placement of the pipe will largely eliminate ditch segment 2 scour concerns and will reduce the possibility of slope failure due to saturation of native soils beneath the waste rock / ground interface. When desilting basins are constructed up-gradient from waste dumps, water seepage usually follows the original ground surface and eventually flows from the toe of the dump. It is anticipated that water captured in the lower basin will be allowed to desilt, then will be used for plant operations.

No ditches are required for the western dump (DA-2, Map R647-4-111.2b). Erosion controls, including slope roughening, will be used to infiltrate moisture and reduce runoff velocities. A basin will be constructed near the toe of the dump expansion limits to desilt potential runoff to the Weber River. The basin will be maintained until vegetation has been re-established following reclamation of the area. A permanent (pre-basin) swale may be constructed as an added sediment control.

111.3 Erosion & Sediment control

DOGM: *Please provide the necessary information to explain how reclaimed areas will satisfy erosion and offsite sedimentation concerns following the reclamation.*

Holnam: Please see response to Section 107.2 and Appendix B.

111.9 Dams & impoundment's left self draining & stable.

DOGM: *Any dams or impoundments left following reclamation must address concerns related to final reclamation and their disposition regarding final post-mining land use.*

Holnam: No dams or impoundments will be left in place after final reclamation of the Overburden Dump.

111.12 Topsoil redistribution

DOGM: *See comments under R647-4-110.5.*

Holnam: This question will be addressed under the soil survey portion of the Overburden Dump letter permit addendum. Topsoil replacement depths will reflect the results of the soil survey to be conducted in 2001. Volume calculations of soil to be salvaged will be submitted with the soil survey.

R647-4-112 - Variance

DOGM: *The application requests that same variance as the original operating permit which exempts the operator from including rock outcrops in the reclamation plan. The variance was granted under Rule M-10(12) when the original permit was issued in 1987. The variance that was granted stated: "Won't seed rock outcrops" and the narrative stated that following operations, "all disturbed areas except the solid outcrops will be shaped and seeded. The soils are good in this area, and there is over fifteen inches of precipitation, so revegetation will not be difficult."*

The variance approved in 1987 applies only to that specific portion of the permit for which is/was issued. Variances are not automatically extended to changes or amendments to the original large mine permit application. Additional variances must include sufficient justification before they will be granted. Since the waste dump is not considered a rock outcrop, the previously approved variance would not apply. If you believe that a variance to a particular reclamation practice(s) is appropriate for the waste dump, please provide all the information required under R647-4-112, including, but not limited to: the rule(s) to which the variance is requested, identification of the area to which the variance will apply, justification for the variance, and proposed alternative methods or measures to be utilized to assure that the proposal will be consistent with the Act.

Holnam: Holnam acknowledges that this variance may not be valid for the Overburden Dump permit revision. Holnam reserves the right to request other variances at the point when the soil and vegetation surveys are completed.

R647-4-113 - Surety

DOGM: *The cost of recontouring and application of topsoil (if a variance for this activity is not issued), over the area covered by this application will need to be included in the surety. An operator's projections for third party costs will be considered when calculating this surety. Copies of contractor's bid should be submitted with the application.*

Holnam: Holnam has obtained a contractor's bid for grading and topsoil placement on the Overburden Dump slopes (last item in the Tables section of this letter). The volume of soil available for reclamation as well as the revegetation seed mixture and fertilizer application rate may be amended following completion of the soil and vegetation surveys in the summer of 2001. Revision of the contractor's bid estimate as well as the revegetation cost estimate may be necessary as a result of these tasks. If so, this information will be submitted as part of the amendment to the Overburden Dump permit.

We appreciate the opportunity to present this revision for the "Notice of Intention" to revise the mining operations for permitting the Overburden Dump at the Devil's Slide Mine in Morgan County, Utah. If you have any questions or require additional information, please contact Kevin Ovard or Ken George.

Sincerely,

Holnam

Kevin Ovard
Environmental Manager

Ken George
Quarry Manager

Tables:
Question 106.3 - Estimated acreage disturbed, reclaimed, annually Reclamation Costs
Question 111.2 - Dump Expansion Hydraulic Analysis (111.2)
Question 111.2 - Dump Expansion Dutch and Riprap Sizing (111.2)
Flare Construction Stripping Bid

Appendices
A: Stability Analysis Computer Output files for the GEOSLOPE software
B: Best Management Practice for Erosion and Sediment Control
C: Hydrology / Hydraulic Support Documentation, Question 111.2
Map R-647-4-111.2a - Drainage Areas
Map R-647-4-111.2b - Drainage Ditches and Desilting Basins, Devil's Slid Mine
Soil Series Descriptions
Isopluvial Maps, NOAA Atlas 2, Volume VI

Figures:
Map DCC-1597 - USGS - Topography Devil's Slide Plant & Quarry Area, Graphical Scale
Map DCC-1597 - Holnam Topography Devil's Slide Plant & Quarry Area, Scale 1" = 400'
Map dcc-1338-97 - Holnam Plan View of the Overburden Dump, Scale 1" = 200'
Map DCC-1702 - Holnam Cross Sections of the Overburden Dump, Scale 1"=200'

106.3 Estimated acreage disturbed, reclaimed, annually

Reclamation Costs*
Devil's Slide Dump Expansion

*Seed mixture supplied by DOGM

Seed Variety	Seed Costs Pounds PLS/Ac	Cost/ PLS/Ac
Tall Wheatgrass (Agrophyron elongatum a.k.a. Elytrigia elongata)	1.0	
Bluebunch wheatgrass (Agropyron spicatum)	2.0	
Orchard Grass (Dactylus glomerata)	0 5	
Basin wildrye (Elymus cinereus)	2.0	
Crested wheatgrass (Agropyron cristatum)	0.5	
Alfalfa (Medicago sativa)	0.5	
Palmer penstemon (Penstemon palmeri)	0.5	
Small Burnet (Sanguisorba minor)	1.5	
Mountain big sagebrush (Artemisia tridentata vaseyana)	0.1	
Rubber rabbitbrush (Chrysothamnus nauseosus)	0.25	
Forage kochia (Kochia prostrata)	0.5	
Antelope bitterbrush (Purshia tridentata)	1.0	
Yellow sweetclover (Melilotus officinalis)	0.5	
Estimated price per PLS per Acre	10.85 PLS	$12.86

Estimate cost for drill seeding Quarry Hollow and Cottonwood areas*

	Meas.	Qty	Cost
Per Acre cost			
Drill and seed	Acre	1 00	326.50
Seed mixture	Acre	1.00	326.50
Total costs			
Drill and seed	**Acre**	**222**	**$72,483.00**
Seed mixture	**Acre**	**222**	**$2,854.92**
			$75,337.92

*Cost developed from estimate provided by Flare Construction

Question 111.2 Reclamation of Natural Channels

DUMP EXPANSION HYDRAULIC SUMMARY

HOLNAM IDEAL CEMENT PLANT - DEVIL'S SLIDE, UTAH

Drainage Area ID / Size / CN [1]	D1-N, Area = 179.9 acres, CN=55				D1-S, Area = 65.7 acres, CN = 71				D2, Area = 156.7 acres, CN = 71			
Storm Event [2]	2/24	10/24	50/24	100/24	2/24	10/24	50/24	100/24	2/24	10/24	50/24	100/24
Rainfall Intensity (inch) [3]	1.6	2.4	3.0	3.2	1.6	2.4	3.0	3.2	1.6	2.4	3.0	3.2
Peak Discharge (cfs)	0.0	1.6	9.5	13.1	2.4	33.2	64.8	76.3	5.7	79.3	154.5	182.0
Average Flow (cfs) [4]	0.0	1.0	2.7	3.4	0.6	2.4	4.0	4.6	1.5	5.7	9.6	11.0
Total Runoff Depth (inch)	0.0	0.1	0.2	0.3	0.1	0.4	0.8	0.9	0.1	0.4	0.8	0.9
Total Runoff Volume (acre-ft)	0.0	1.0	2.9	3.8	0.7	2.4	4.2	4.8	1.65	5.8	9.9	11.5
Basin Capacity (acre-ft) [5]	0.0	0.2	1.2	1.7	NA	2.0 [6]	NA	NA	0.76	3.5	6.4	7.5

[1] Drainage Areas

Drainage Areas	acres
DA-1	245.612
DA-2	156.707
Sub-Areas	
DA-1N	179.897
DA-1S (top)	65.715
DA-1S (slope)	14.538

[1] Curve Numbers derived from following information:

St. Marys	gravelly loam	medium to rapid runoff
Hoskin	cobbly loam	medium to rapid runoff
Henefer	silt loam	medium to slow runoff
Kilfoil	loam	medium runoff

Antecedent Moisture Condition II (avg moisture)

All are loam and well drained. Use SCS Hydrologic Soil Grouping B.

Drainage Area DA-1N (native)

Forest - good cover — CN 55 — (no grazing, good litter and brush cover soil)

Drainage Area DA-1S (top), DA-1S (slope) and DA-2. All dump expansion.

Finsihed dumps — CN 71 — (resemble cultivated fields with conservation treatment)

[2] 2/24 descibes the storm event, i.e., 2/24 is 2 year / 24 hour storm.

[3] Rainfall intensities taken from Utah Isopluvial (hyetograph) map, NOAA Atlas 2, Volume VI.

[4] Average flow from start of runoff. Takes into account infiltration and time of concentration.

[5] Construct basin to contain this volume.

[6] Basin capacity includes runoff from a dump section that is outside the dump expansion area (DA-1S(slope)). Value shown is volume for the combined area.

Notes:

During expansion activities, higher runoff values will come from dump tops (compacted surfaces).

Once vegetation is fully established, the CN for the finished dumps will be different and the runoff reduced.

DUMP EXPANSION DITCH AND RIPRAP SIZING
HOLNAM IDEAL CEMENT PLANT - DEVIL'S SLIDE, UTAH

Ditch / Channel Location	Area of Runoff (ft^2)	Qmax (cfs)	Vtot (acre-ft)	Ditch		slope	depth of flow (ft)	area of flow (ft^2)	wetted perimeter (ft)	hydraulic radius (ft)	Vavg (eqn) (ft/s)	Vmax (Qmax/A) (ft/s)	Riprap Size (d50) (inch)
				Rise (ft)	Run (ft)	s (ft/ft)							
DA-1N (native)	7,836,309	1.6	1.0	No ditch.			-	-	-	-	-	-	
DA-1S (top)	2,862,530	33.2	2.4				-	-	-	-	-	-	
Ditch 1	10,698,839	34.8	3.4	10	1890	.0053	1.72	8.92	10.90	0.82	3.2	3.9	4
DA-1S (slope) [1]	633,283	7.4	0.5				-	-	-	-	-	-	
Ditch 2	11,332,122	42.2	3.9	400	1181	.3387	0.85	2.16	5.37	0.40	15.8	19.5	40 [2]
DA-2	6,826,151	79.3	5.8	No ditch.			-	-	-	-	-	-	

[1] DA-1S (slope) is outside of dump expansion area. It has been added for calculation of runoff for that segment of ditch.

[2] Recommend piping with energy dissipators at bottom of slope.

Ditches not required for drainage areas DA-1N and D2.
Hydraulic data was calculated separately for drainage ditch design. Upgradient drainage areas added in incrementally for each ditch section.
top ditch - runoff from DA-1N (native) and DA-1S (top of dump).
sloped ditch - runoff from all areas, including DA-1S (slope).
Riprap for sloped fill area DA-1S (ditch segment 2, Map) assumes west side dump-native interface already armored.

Qmax = maximum discharge
V(tot) = total storm runoff
depth of flow = (Q/(.56*(Z/n)*(s^.5))^.375
Z and n are ditch size coefficients
H.R. = hydraulic radius = area of ditch/ wetted perimeter

Vavg = velocity of flow = (1.49/n)*(R^(2/3))*(s^(1/2))
n = Mannings coefficient
R = hydraulic radius
s = ditch slope

Flare Construction inc.

Post Office Box 134 • Coalville, Utah 84017 • Telephone (801) 336 2888

118.9
ACRES
TO STRIP

Tuesday, March 13, 2001

Estimate Only*

To: Ken George, Holnam
From: Chad Simister, Flare Construction, Inc.
Date: March 12, 2001
RE: Estimate for striping of Quarry Hollow and Cottonwood.
For bonding purposes.

Item	Description	Meas.	Qty	Total Cost	
1.	**Strip Quarry Hollow Area** Strip the site down 10" and stockpile material.	CY	85,000	$342,000.00	4.02/yd³ 129,900
2.	**Strip Cottonwood Hollow Area** Strip the site down 10" and stockpile material.	CY	65,000	$270,000.00	4.15/yd³ 69,600
3.	**Build Access Roads for Construction**	LS	1	$71,340.00	
4.	**Reclaim Quarry Hollow Area** Spread 10" of material over stockpile material.	CY	85,000	$204,500.00	2.406/yd³
5.	**Reclaim Cottonwood Hollow Area** Spread 10" of material over stockpile material.	CY	65,000	$182,360.00	2.806/yd³

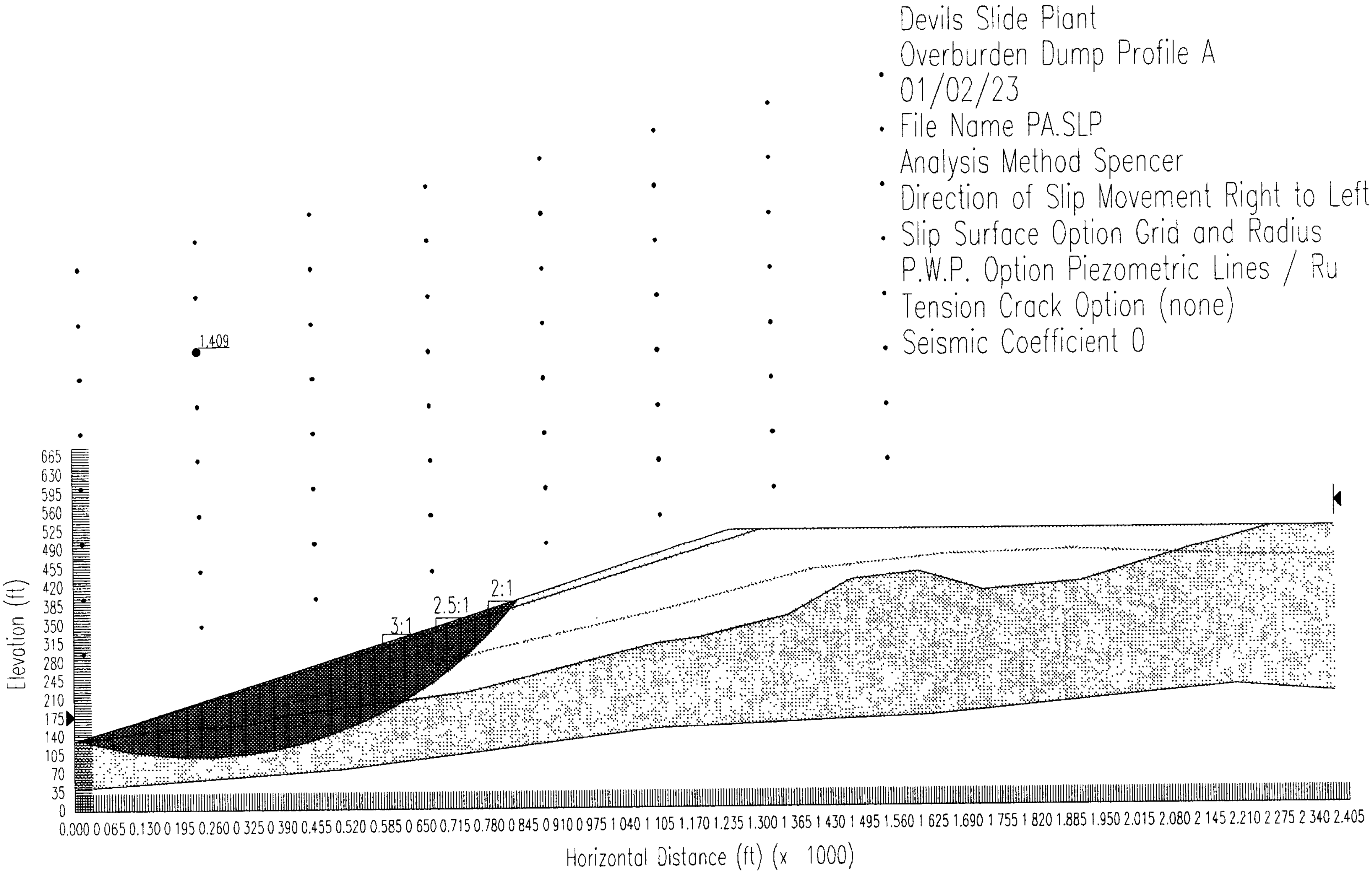
Conditions & Exclusions:

1. Estimate based on drawings and quantities from Holnam.
2. Estimate based on 1 mobilization and clearing site all at once.
3. Estimate does not include seeding.

Respectfully,

Chad Simister
Estimator

STRIP STOCKPILE
THEN
STRIP & LIVE HAUL
SPREAD, RIP & SEED
??
MOB & DEMOB



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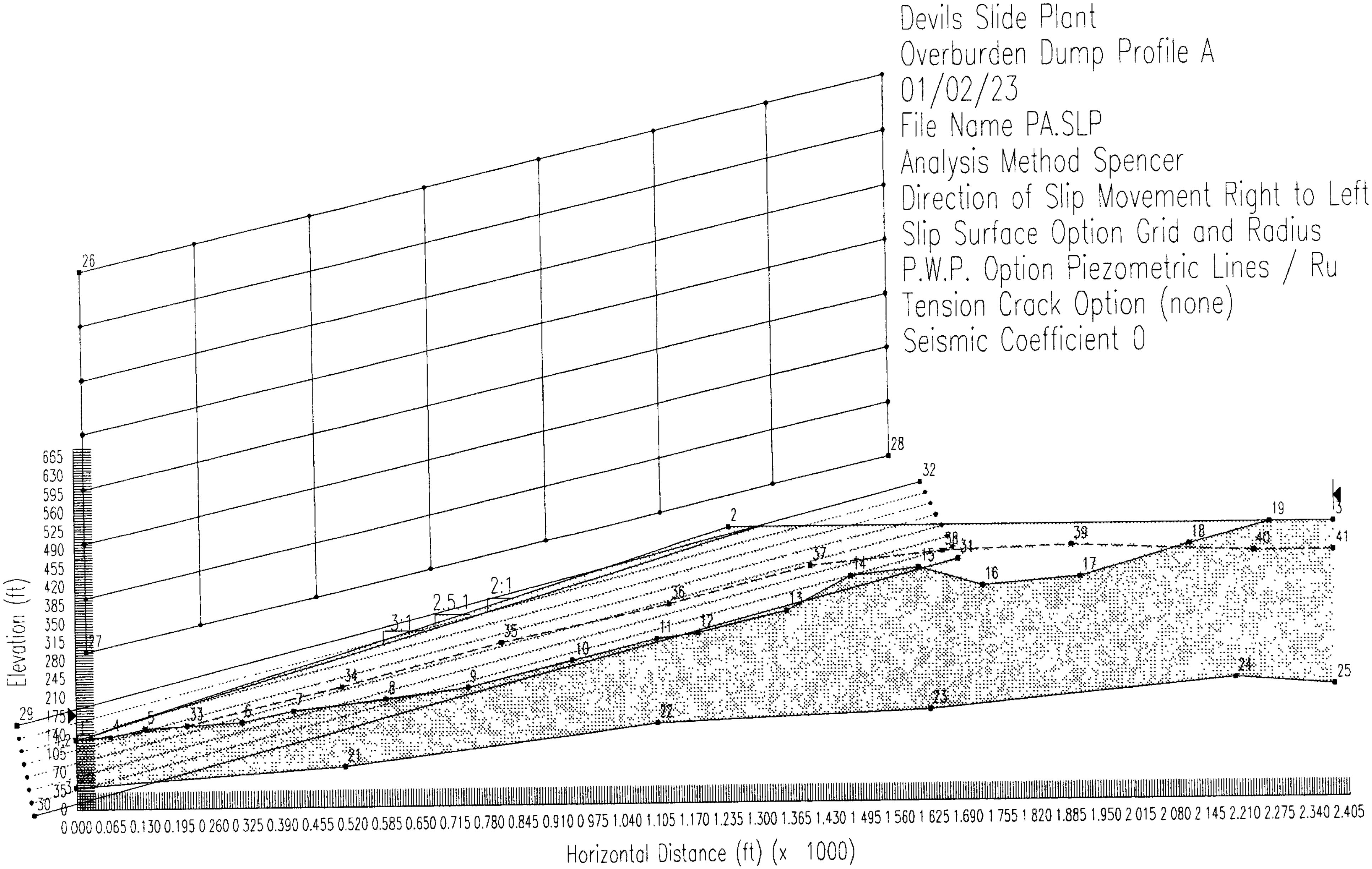
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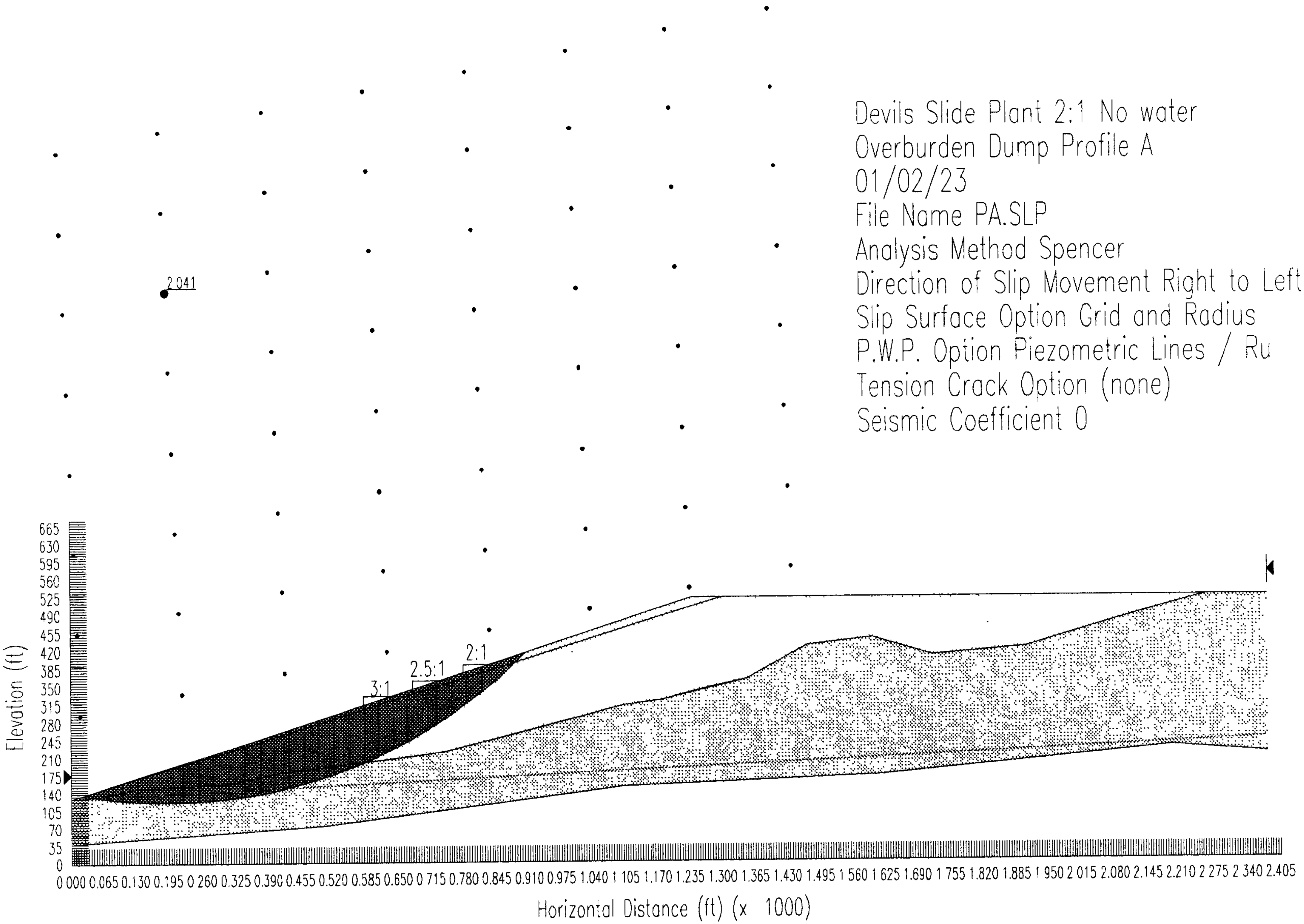

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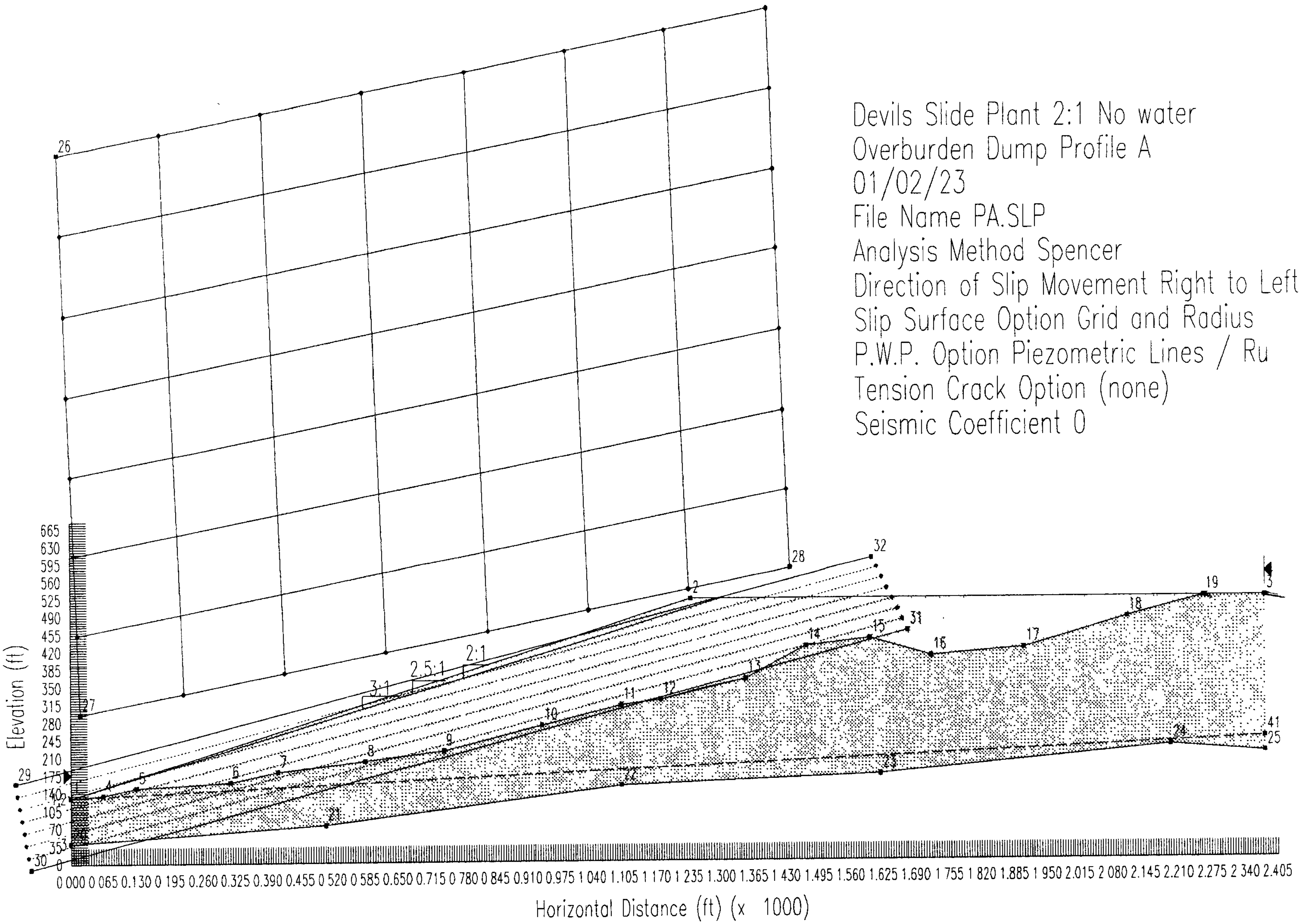

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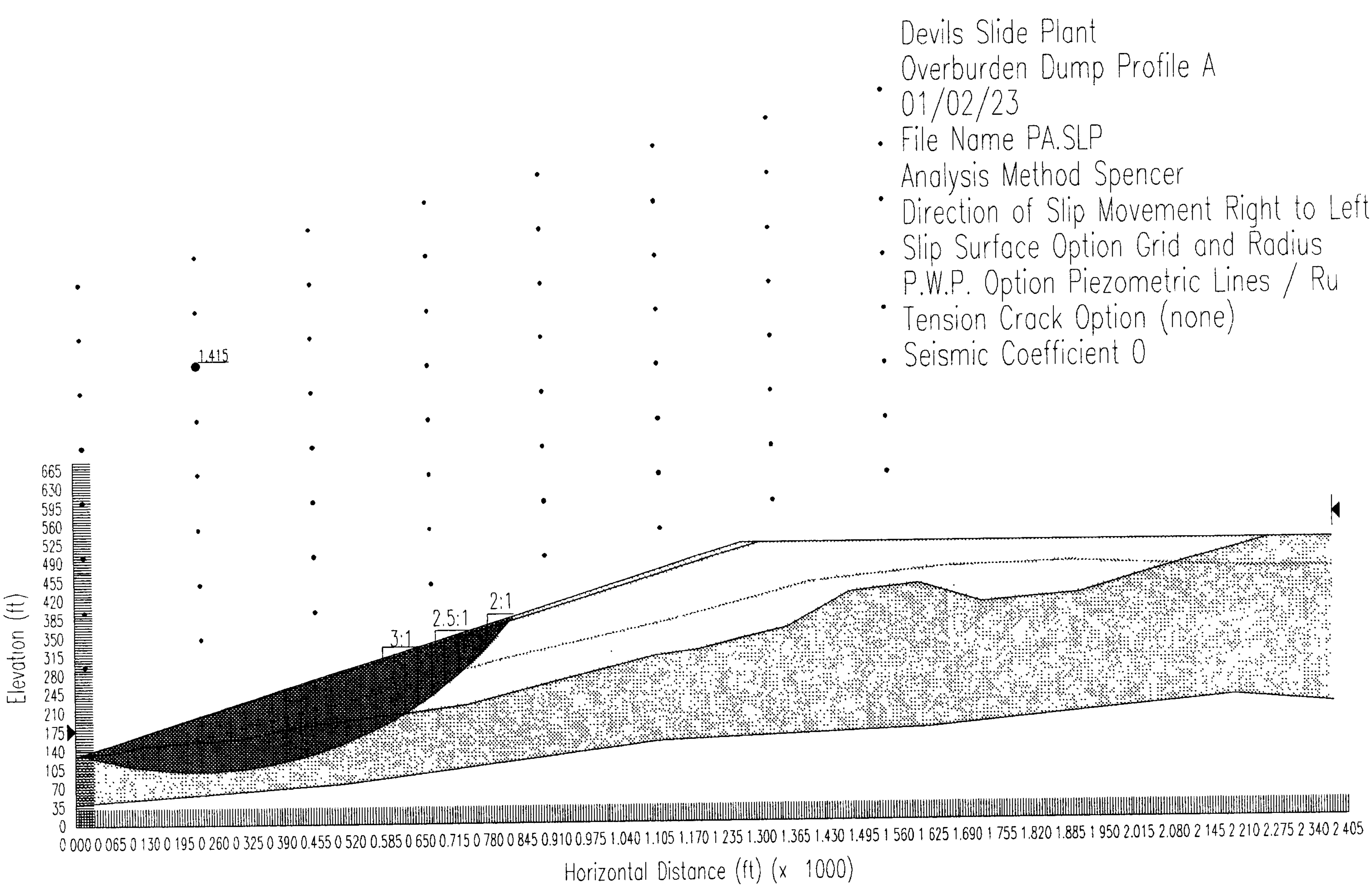

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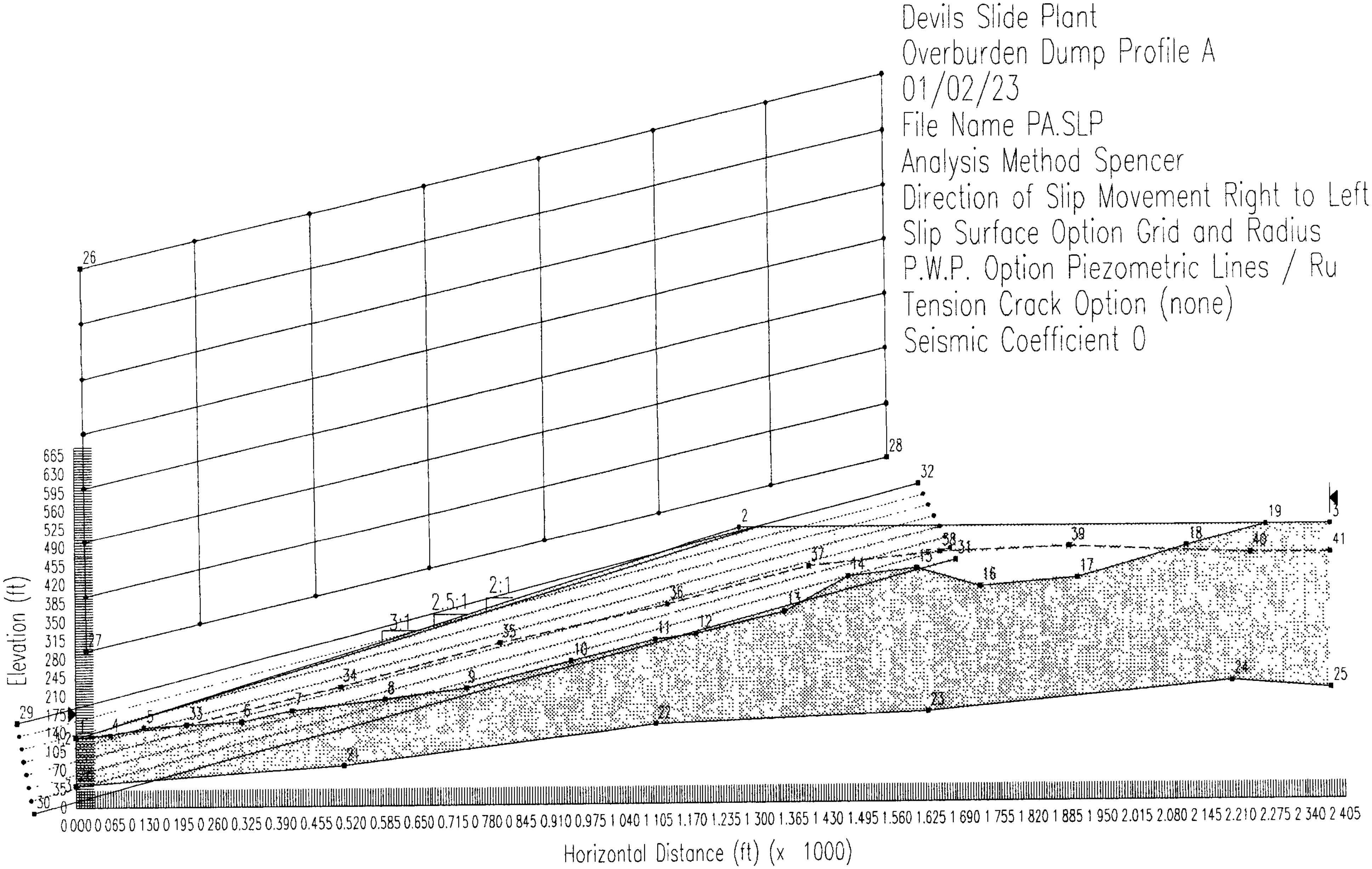

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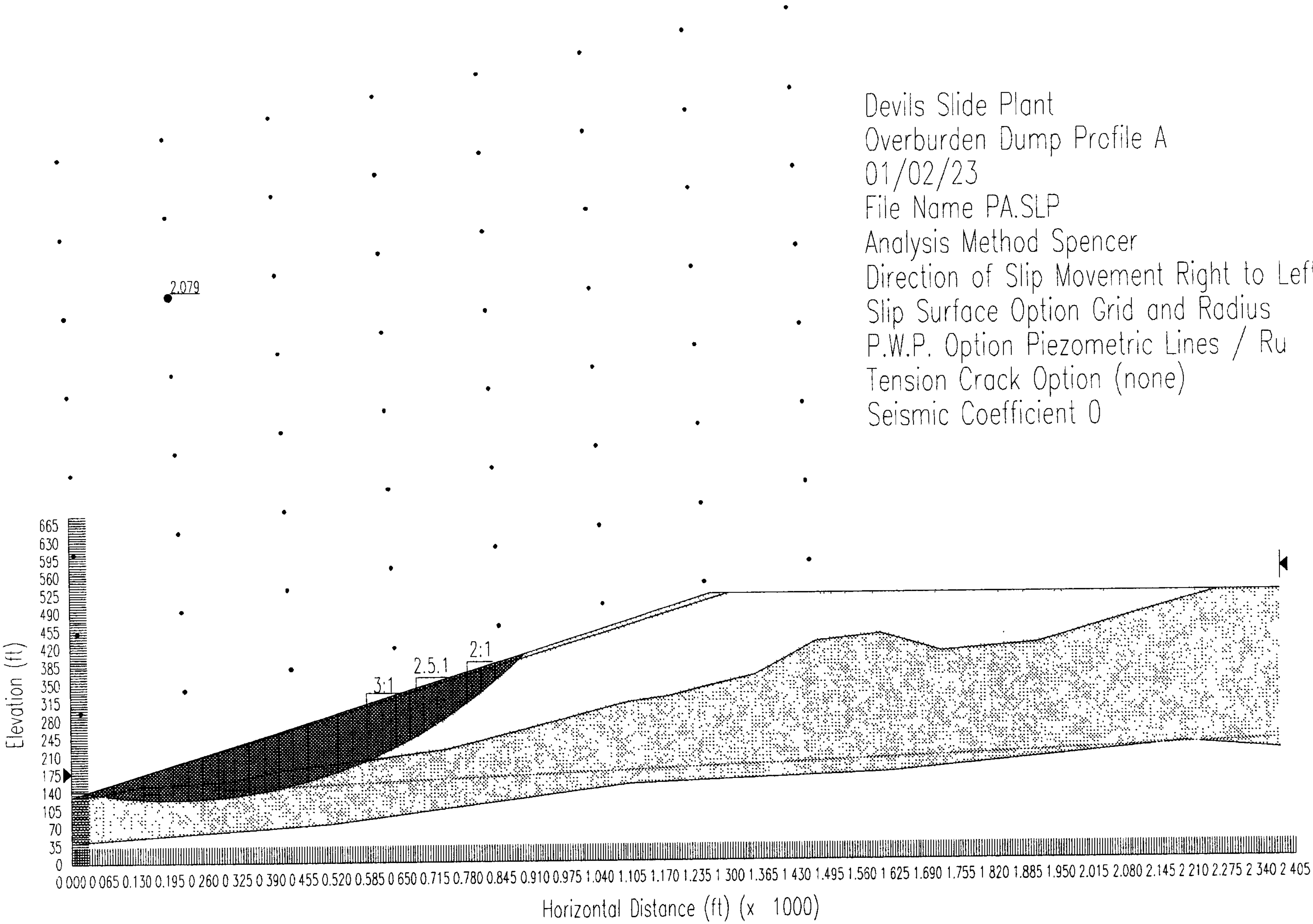
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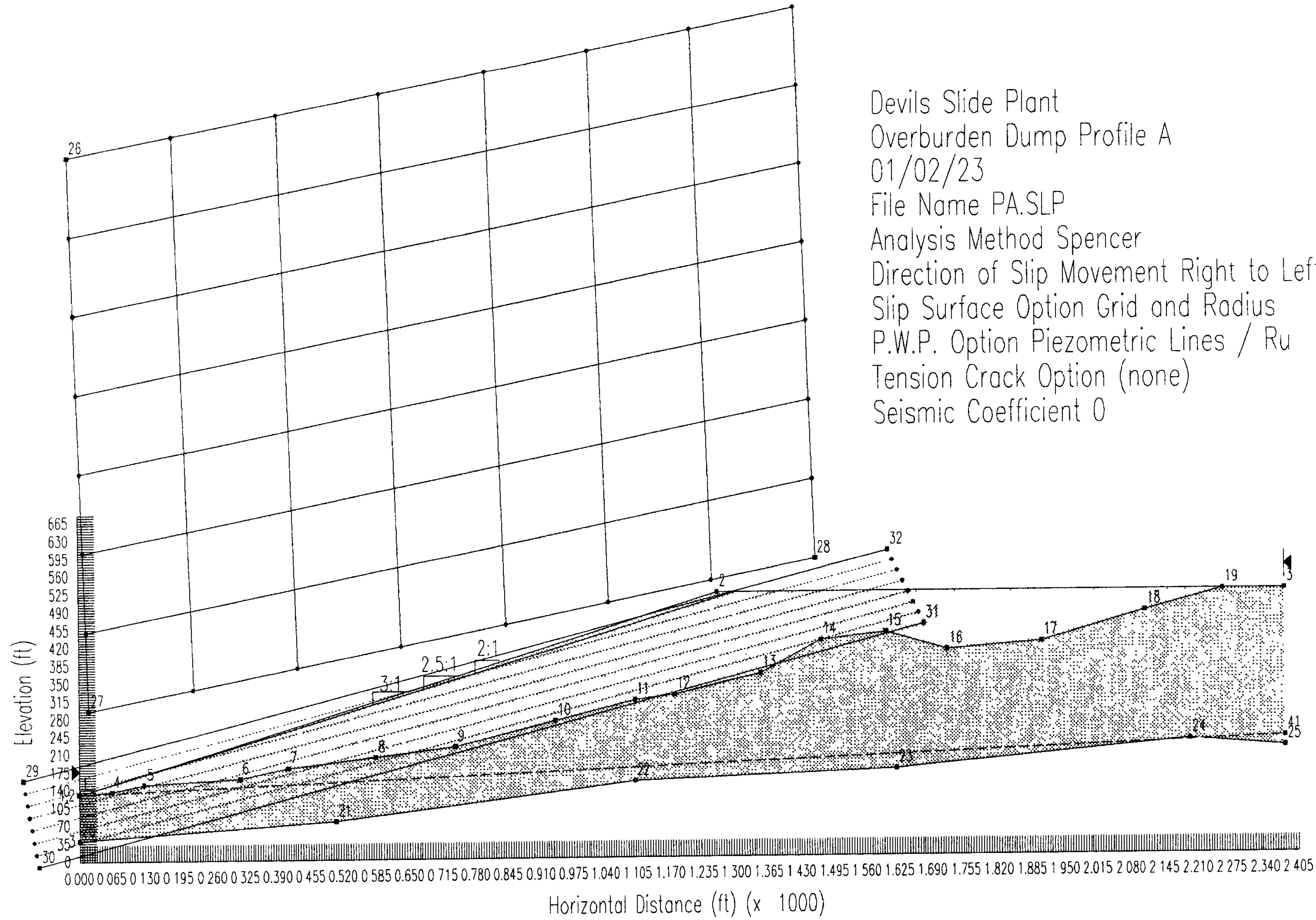
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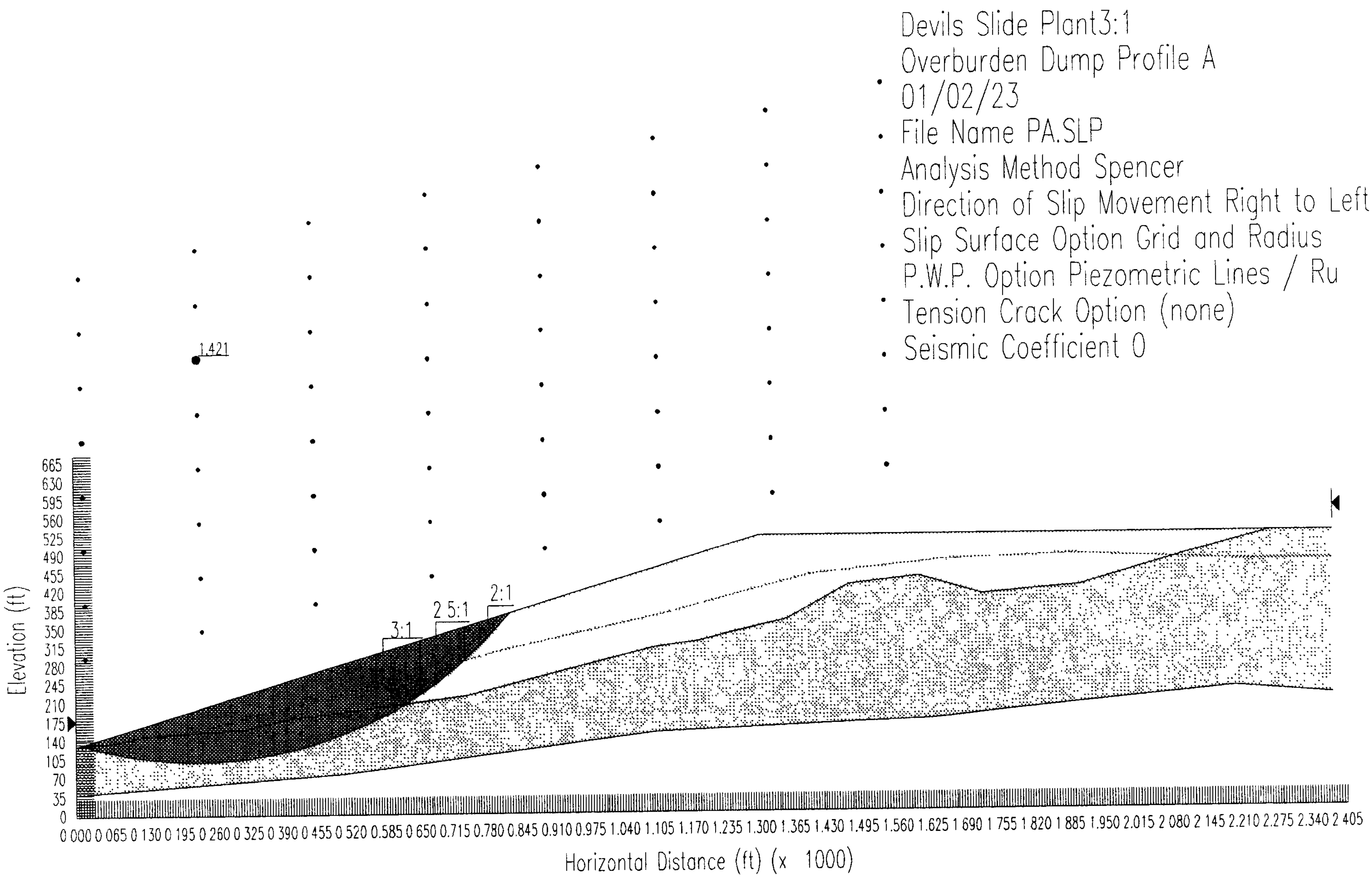

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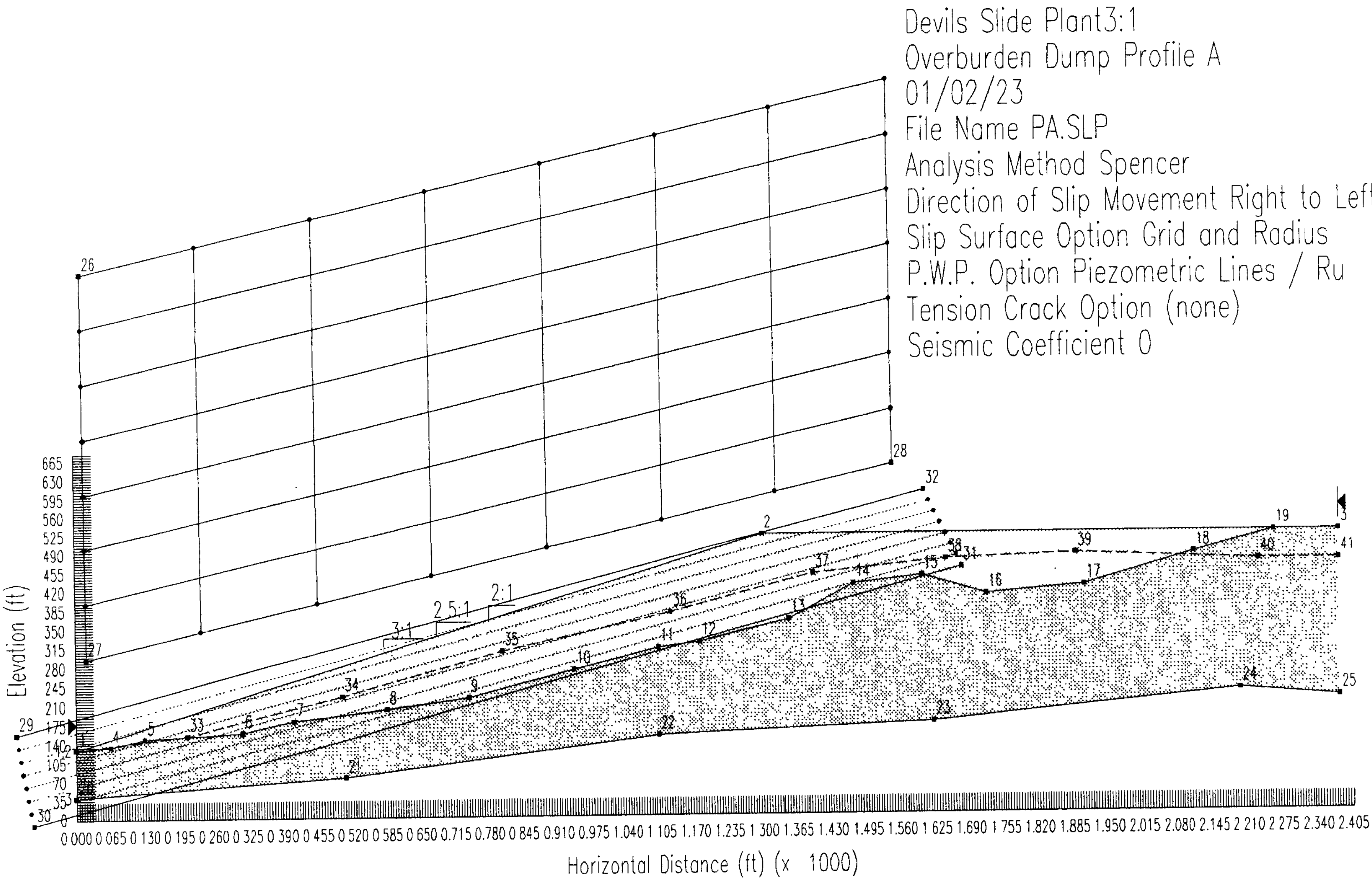
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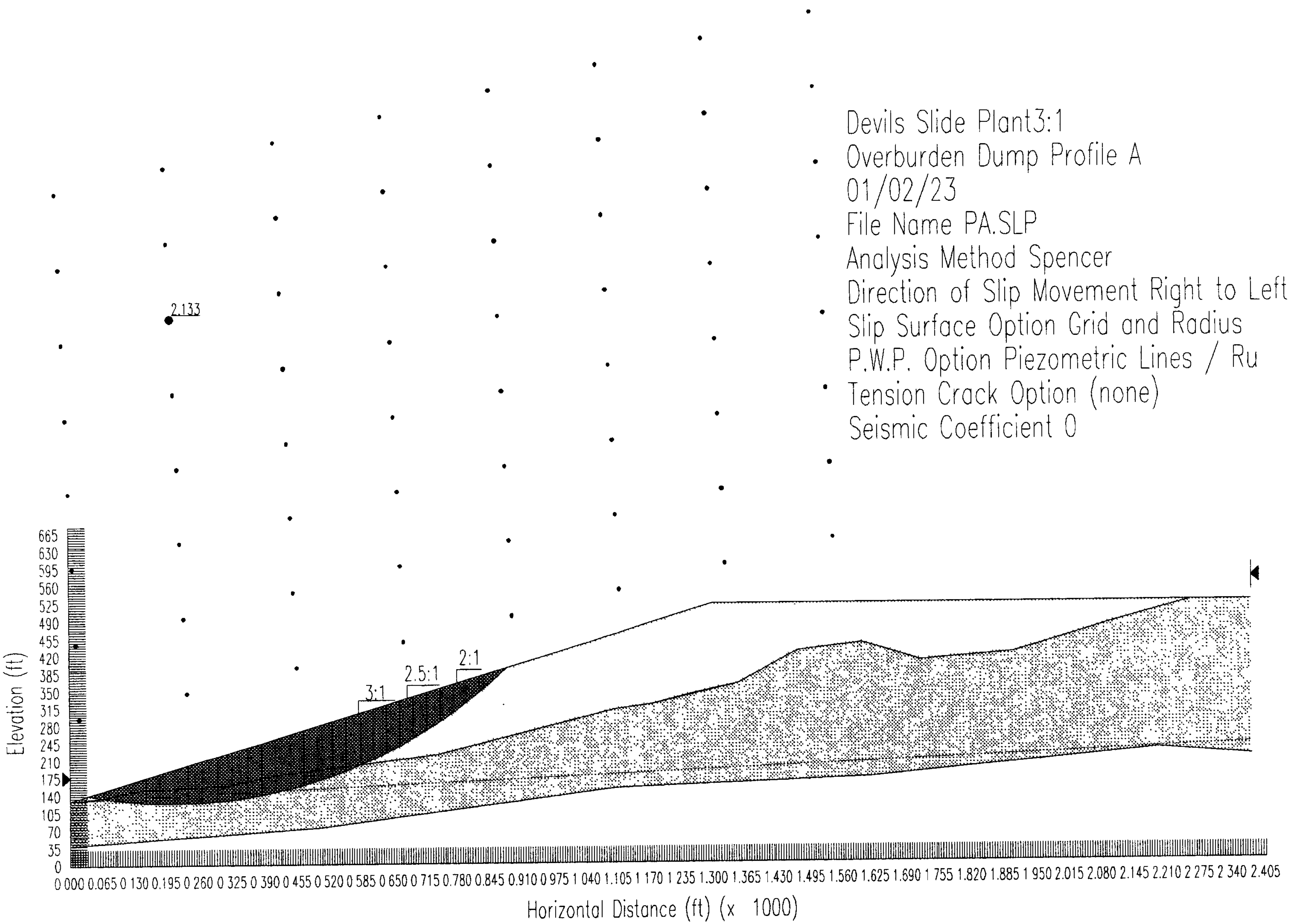
Horizontal Distance (ft) (x 1000)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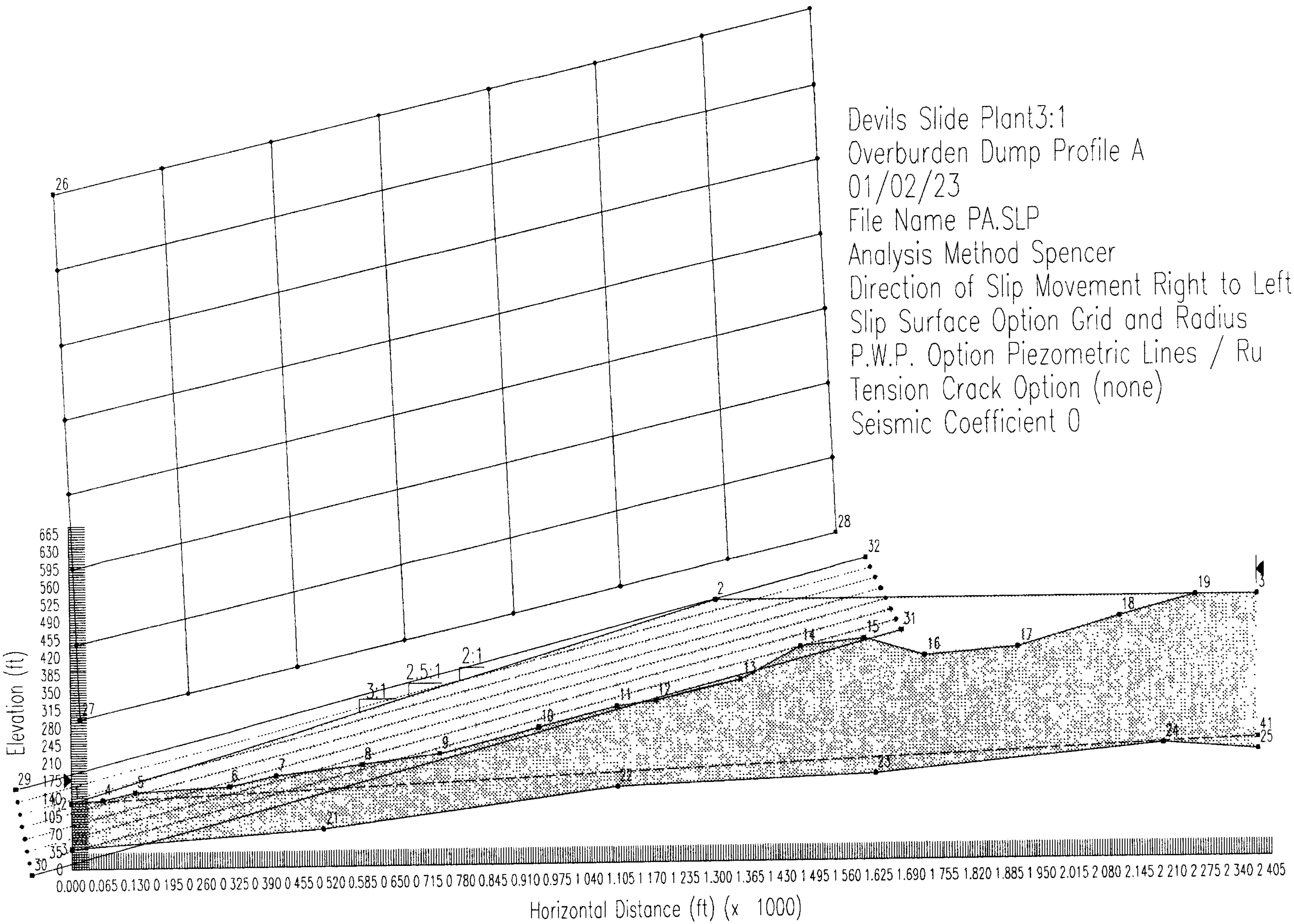
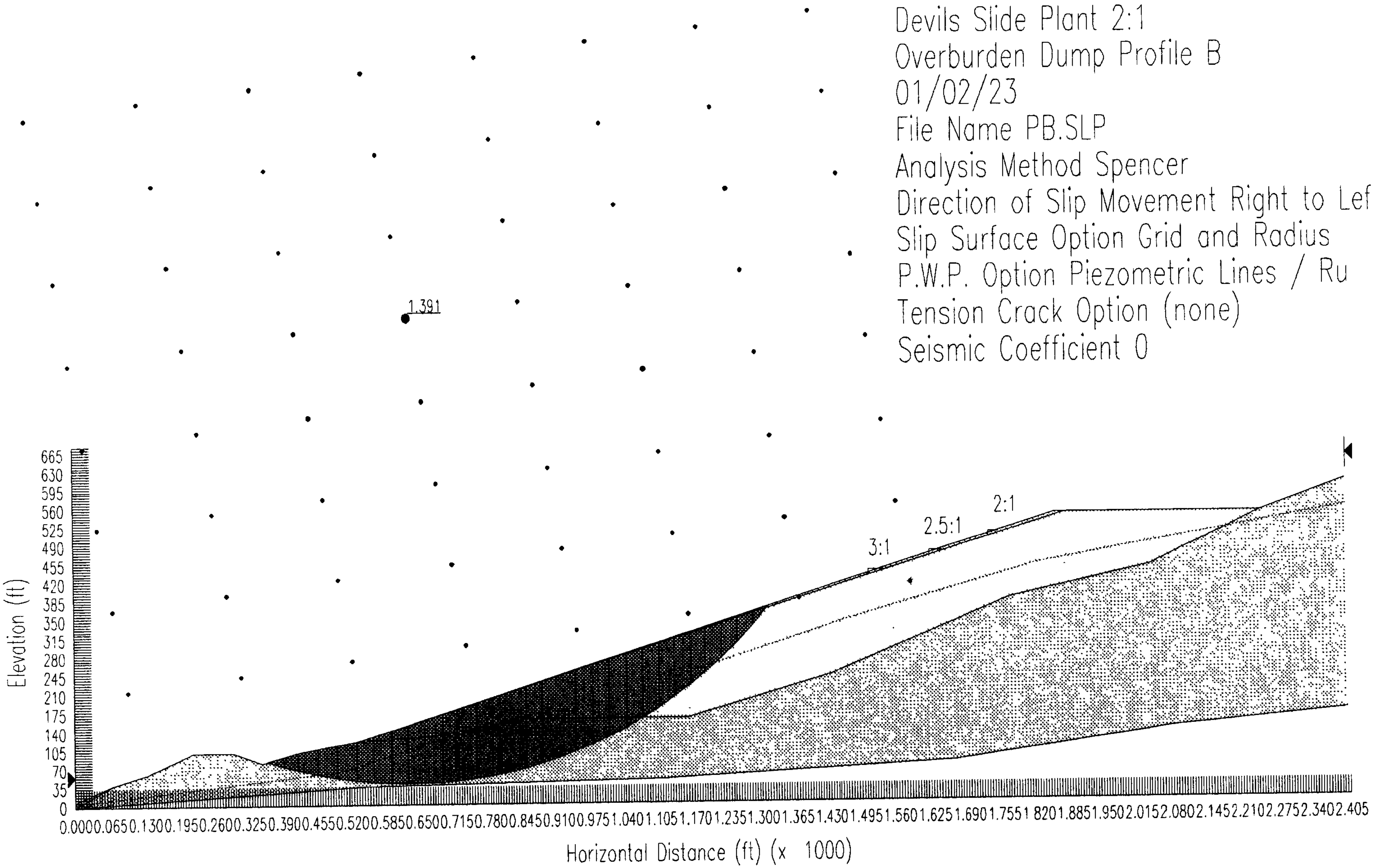
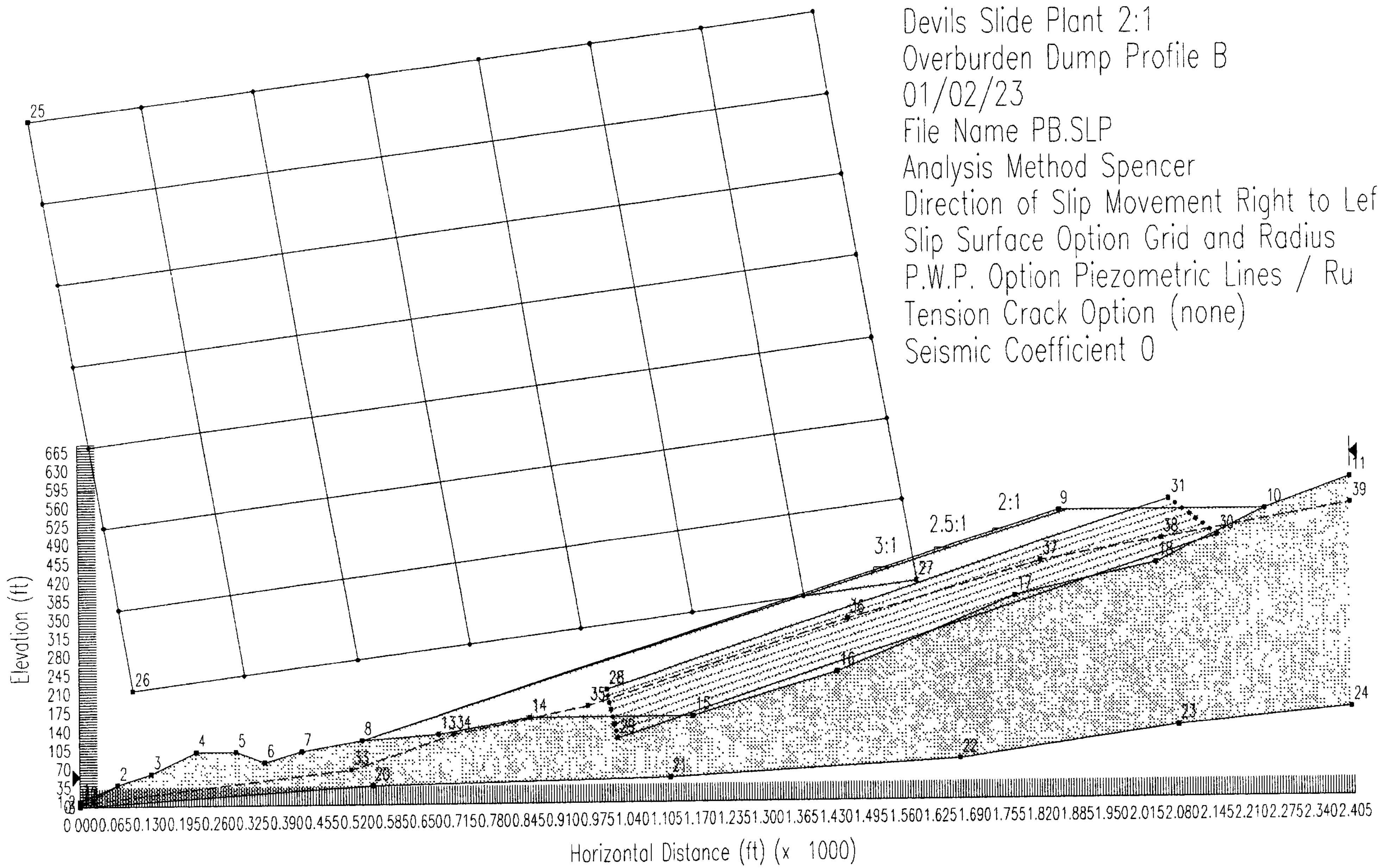
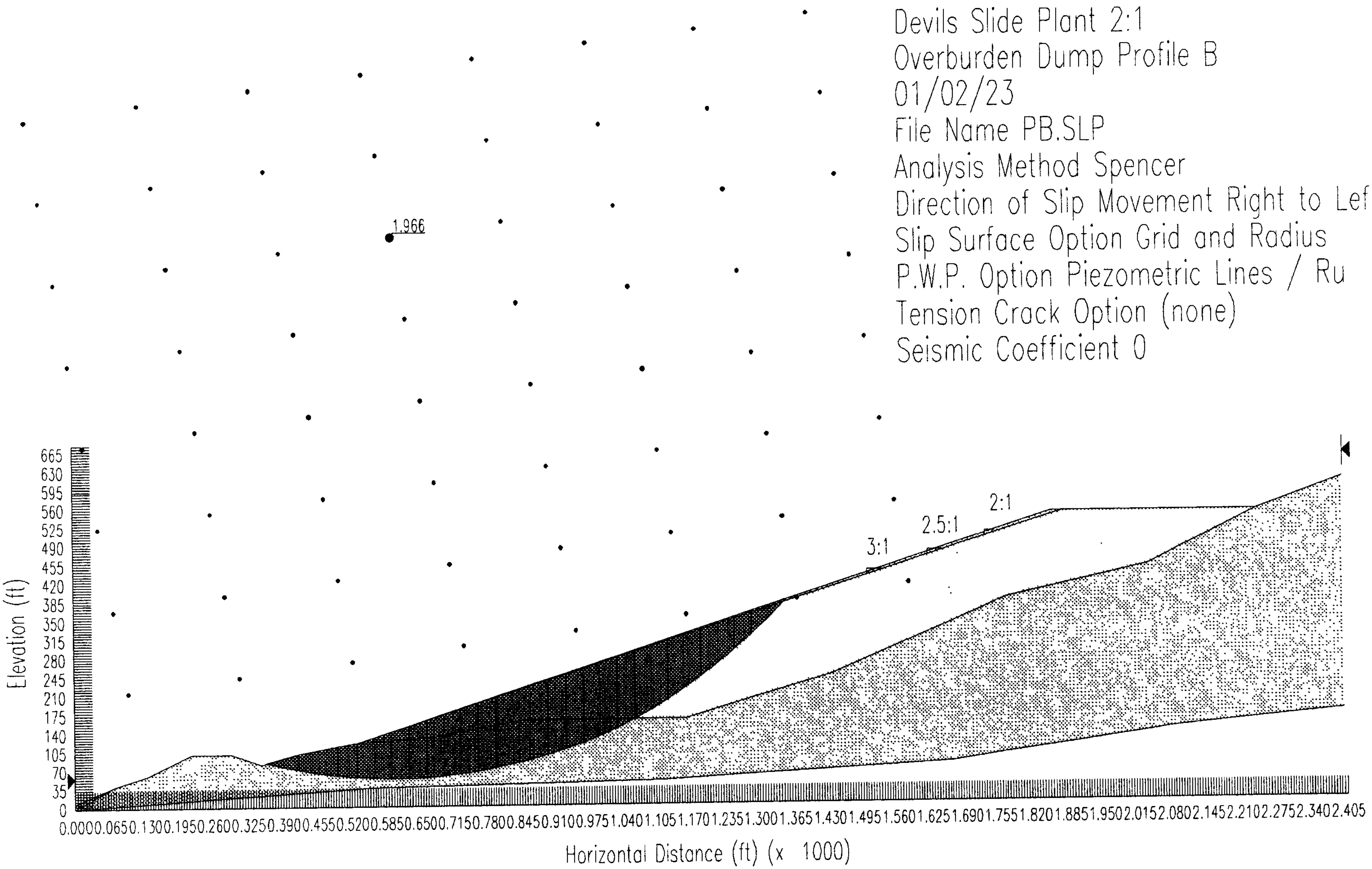
Elevation (ft)
665 630 595 560 525 490 455 420 385 350 315 280 245 210 175 140 105 70 35 0
0.000 0.065 0.130 0.195 0.260 0.325 0.390 0.455 0.520 0.585 0.650 0.715 0.780 0.845 0.910 0.975 1.040 1.105 1.170 1.235 1.300 1.365 1.430 1.495 1.560 1.625 1.690 1.755 1.820 1.885 1.950 2.015 2.080 2.145 2.210 2.275 2.340 2.405
Horizontal Distance (ft) (x 1000)

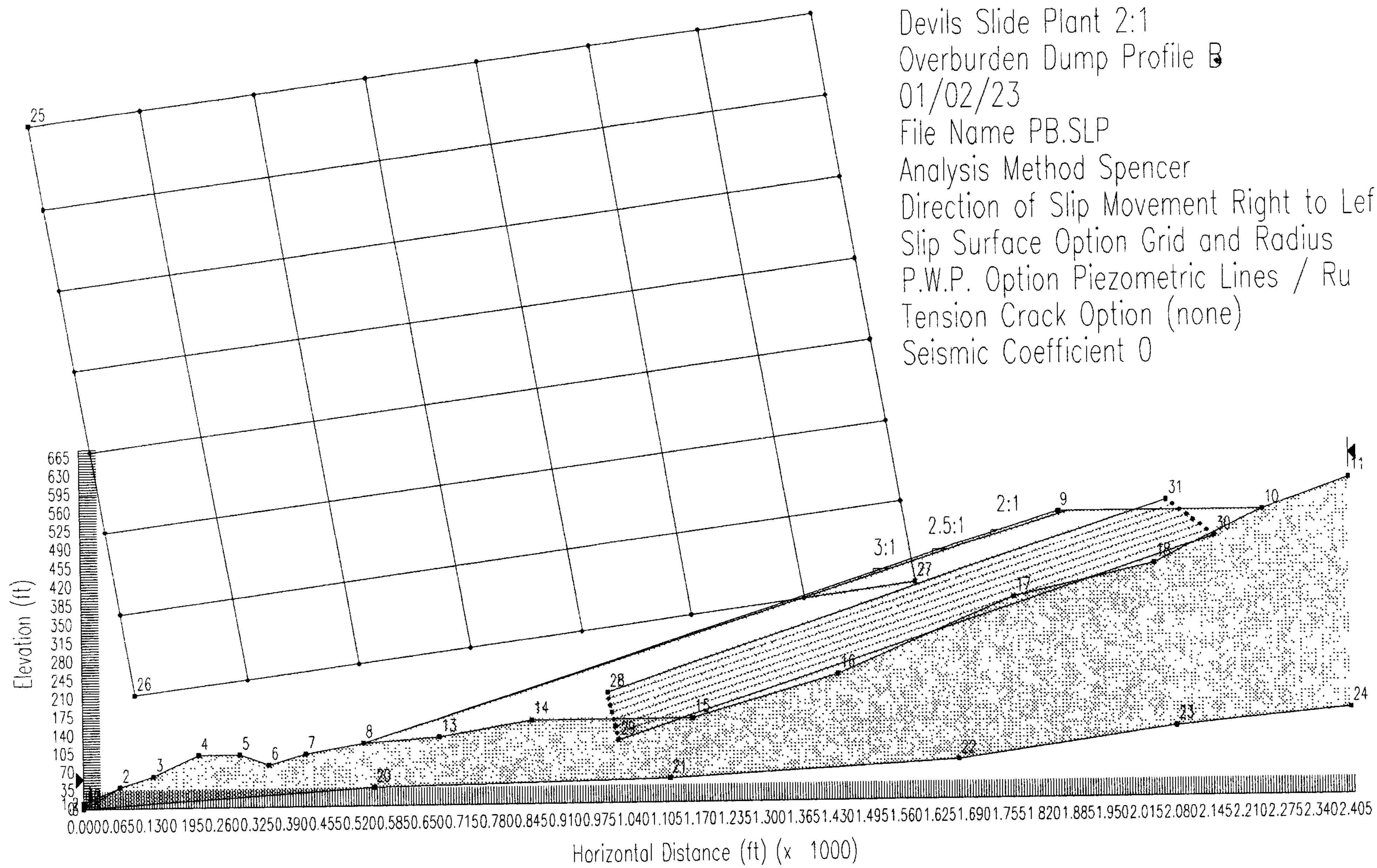


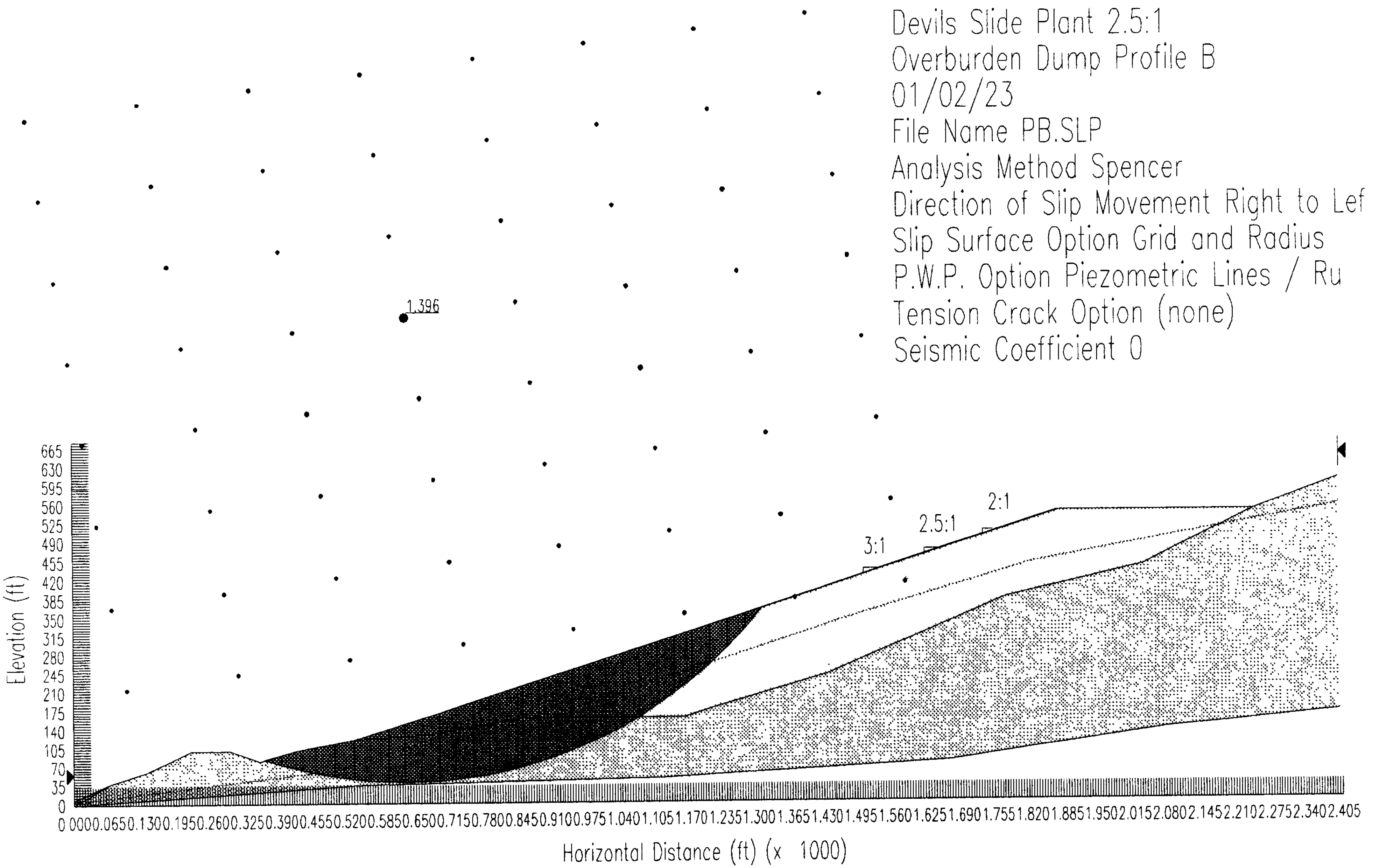
Devils Slide Plant3:1
Overburden Dump Profile A
01/02/23
File Name PA.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Left
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
3:1
2.5:1
2:1
Elevation (ft)
Horizontal Distance (ft) (x 1000)

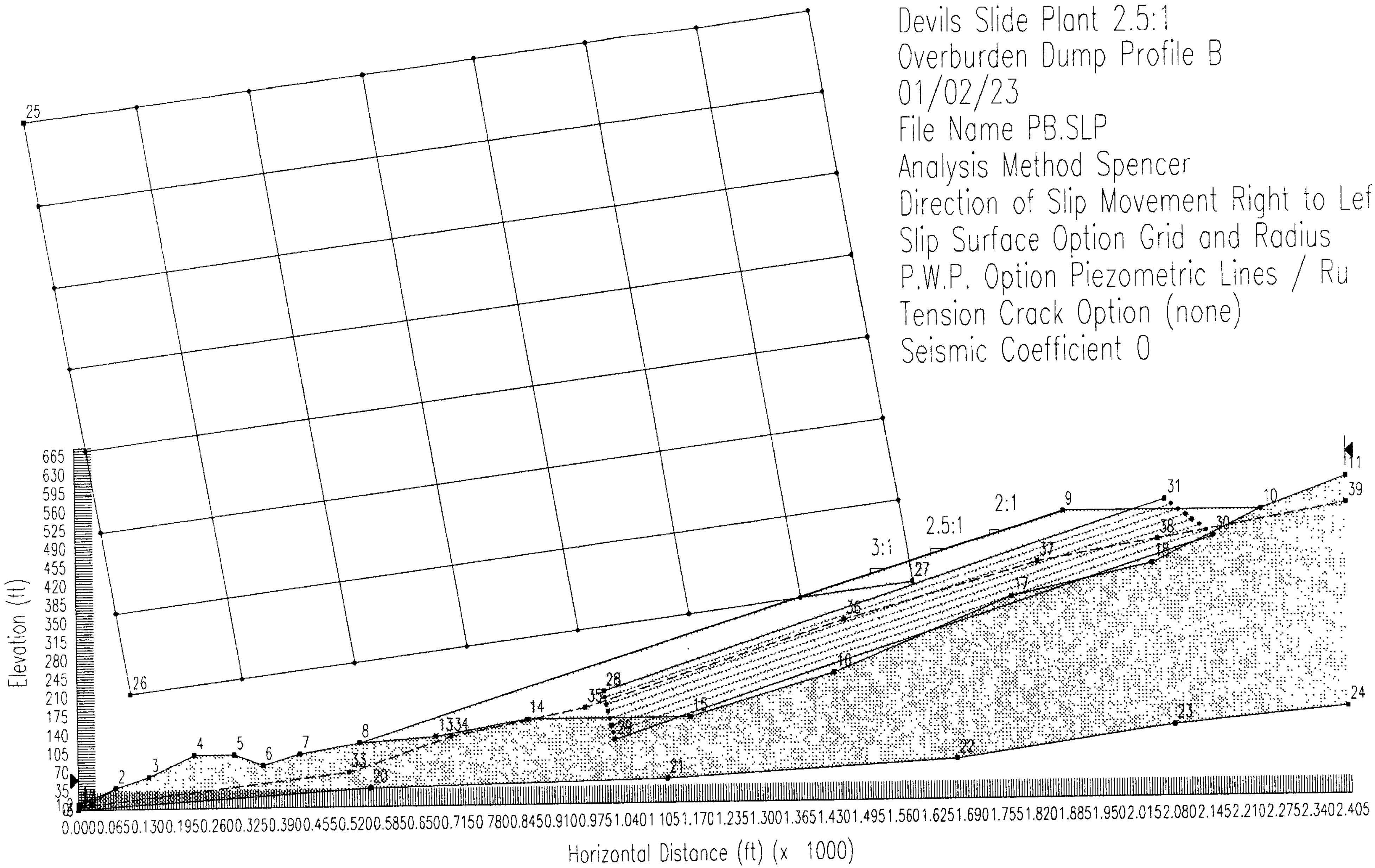

Devils Slide Plant 2:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
1.391
3:1
2.5:1
2:1
Elevation (ft)
665
630
595
560
525
490
455
420
385
350
315
280
245
210
175
140
105
70
35
0
0.0000.0650.1300.1950.2600.3250.3900.4550.5200.5850.6500.7150.7800.8450.9100.9751.0401.1051.1701.2351.3001.3651.4301.4951.5601.6251.6901.7551.8201.8851.9502.0152.0802.1452.2102.2752.3402.405
Horizontal Distance (ft) (x 1000)


Devils Slide Plant 2:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
3:1
2.5:1
2:1
Elevation (ft)
Horizontal Distance (ft) (x 1000)

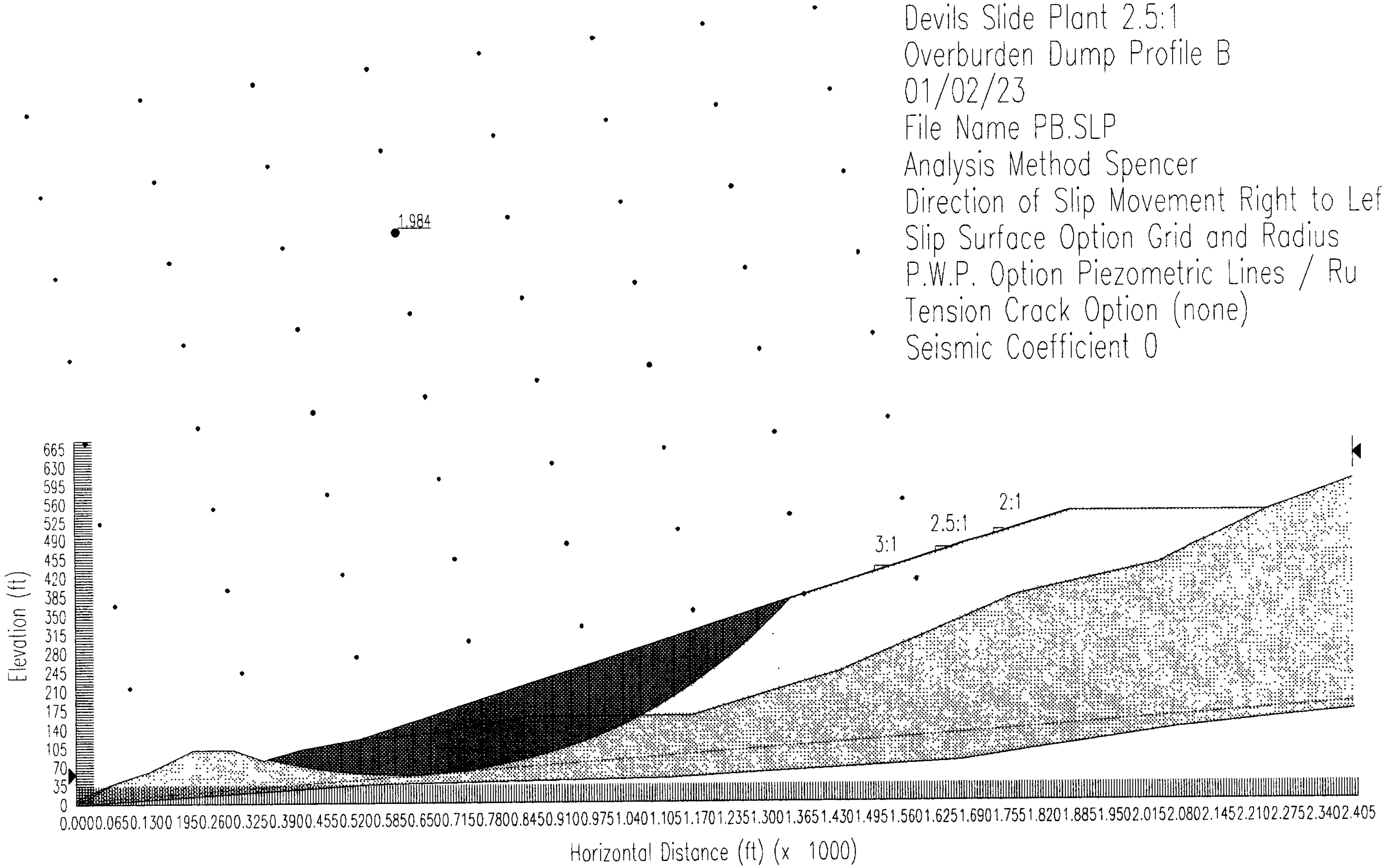

Devils Slide Plant 2:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
1.966
3:1
2.5:1
2:1
Elevation (ft)
665 630 595 560 525 490 455 420 385 350 315 280 245 210 175 140 105 70 35 0
0.000 0.065 0.130 0.195 0.260 0.325 0.390 0.455 0.520 0.585 0.650 0.715 0.780 0.845 0.910 0.975 1.040 1.105 1.170 1.235 1.300 1.365 1.430 1.495 1.560 1.625 1.690 1.755 1.820 1.885 1.950 2.015 2.080 2.145 2.210 2.275 2.340 2.405
Horizontal Distance (ft) (x 1000)


Devils Slide Plant 2:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
3:1
2.5:1
2:1
Elevation (ft)
Horizontal Distance (ft) (x 1000)

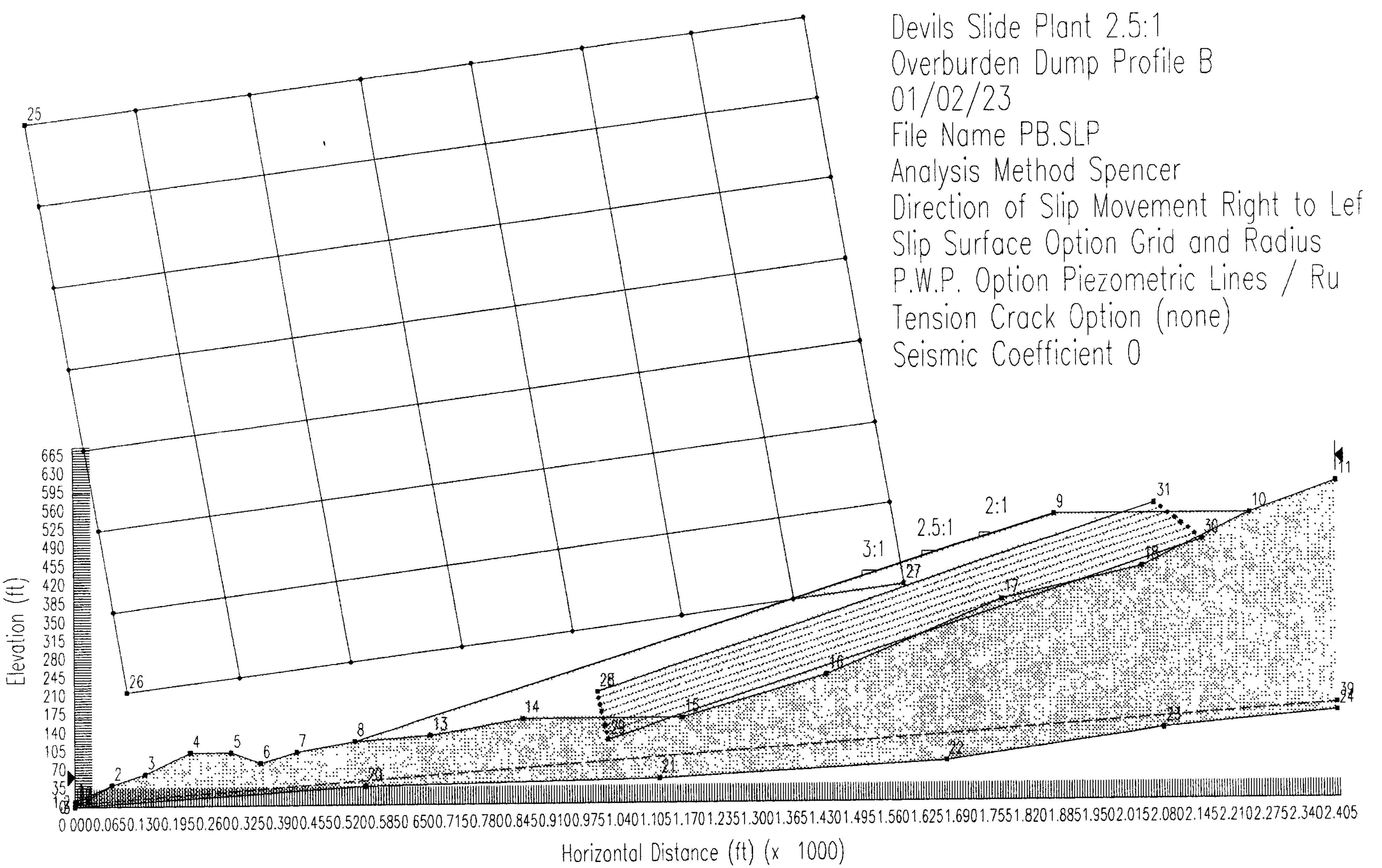

Devils Slide Plant 2.5:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
1.396
3:1
2.5:1
2:1
Elevation (ft)
Horizontal Distance (ft) (x 1000)



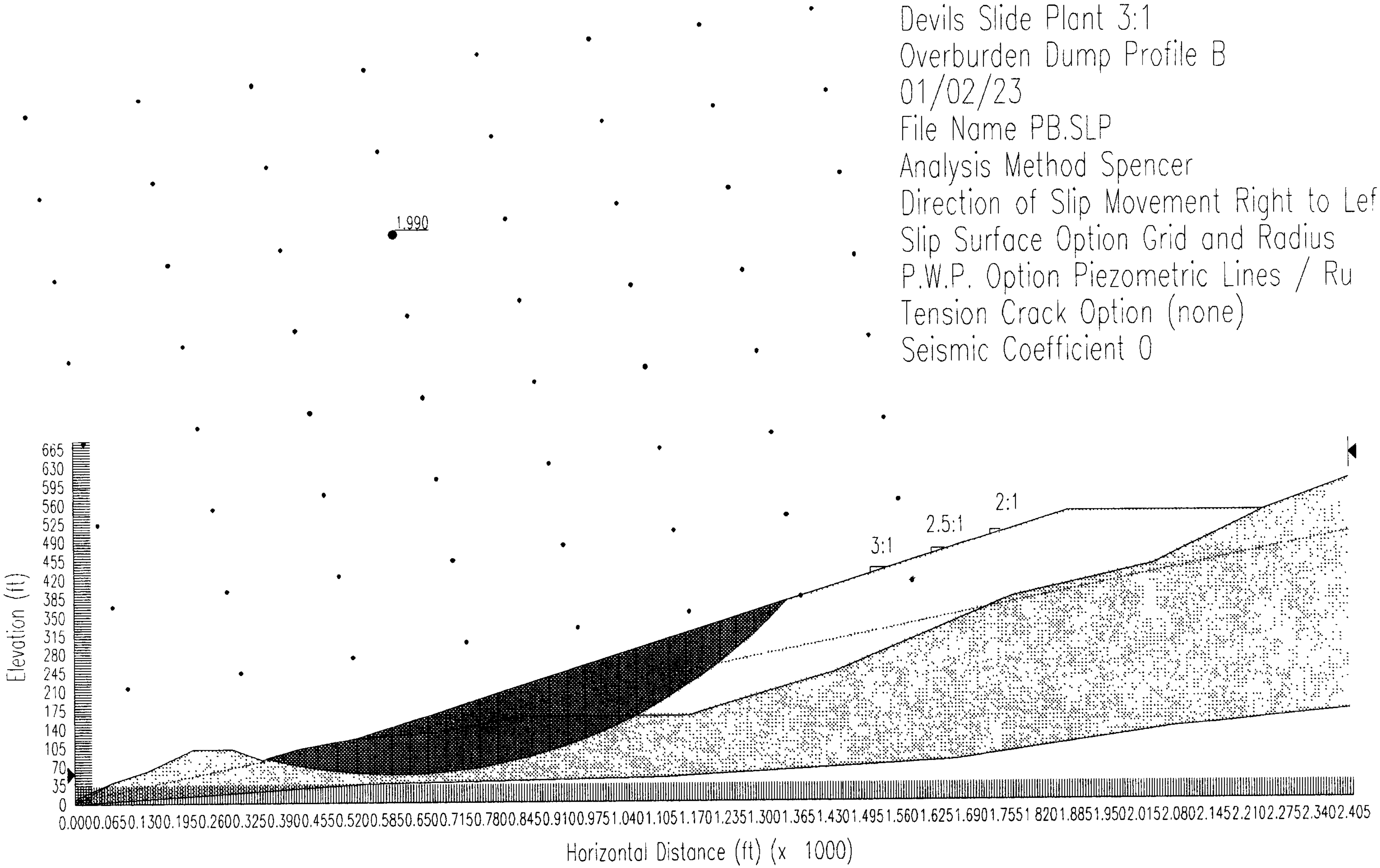
Devils Slide Plant 2.5:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
3:1
2.5:1
2:1
Elevation (ft)
Horizontal Distance (ft) (x 1000)



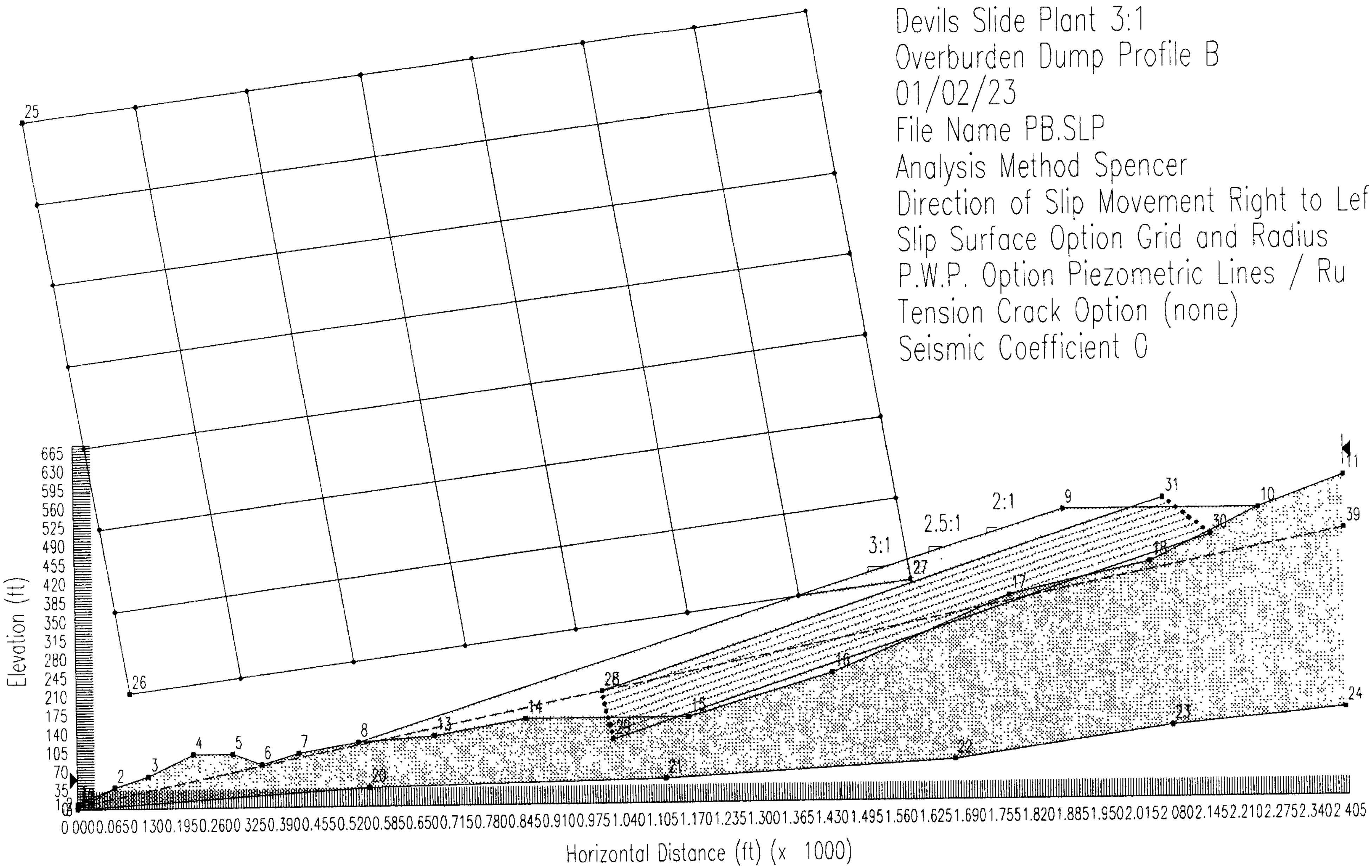
Devils Slide Plant 2.5:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
1.984
3:1
2.5:1
2:1
Elevation (ft)
665
630
595
560
525
490
455
420
385
350
315
280
245
210
175
140
105
70
35
0
0.0000.0650.1300.1950.2600.3250.3900.4550.5200.5850.6500.7150.7800.8450.9100.9751.0401.1051.1701.2351.3001.3651.4301.4951.5601.6251.6901.7551.8201.8851.9502.0152.0802.1452.2102.2752.3402.405
Horizontal Distance (ft) (x 1000)



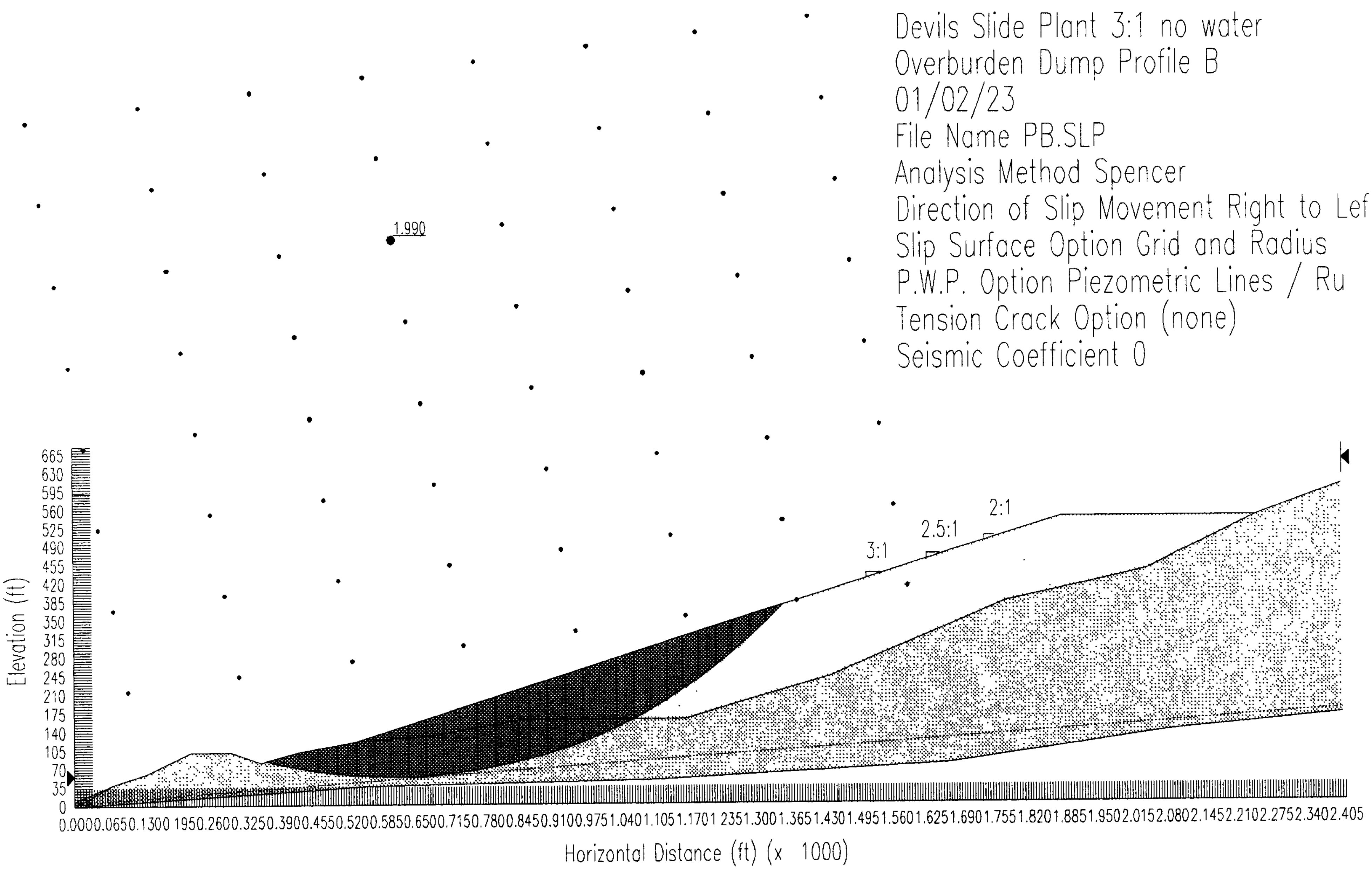
Devils Slide Plant 2.5:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
3:1
2.5:1
2:1
Elevation (ft)
Horizontal Distance (ft) (x 1000)

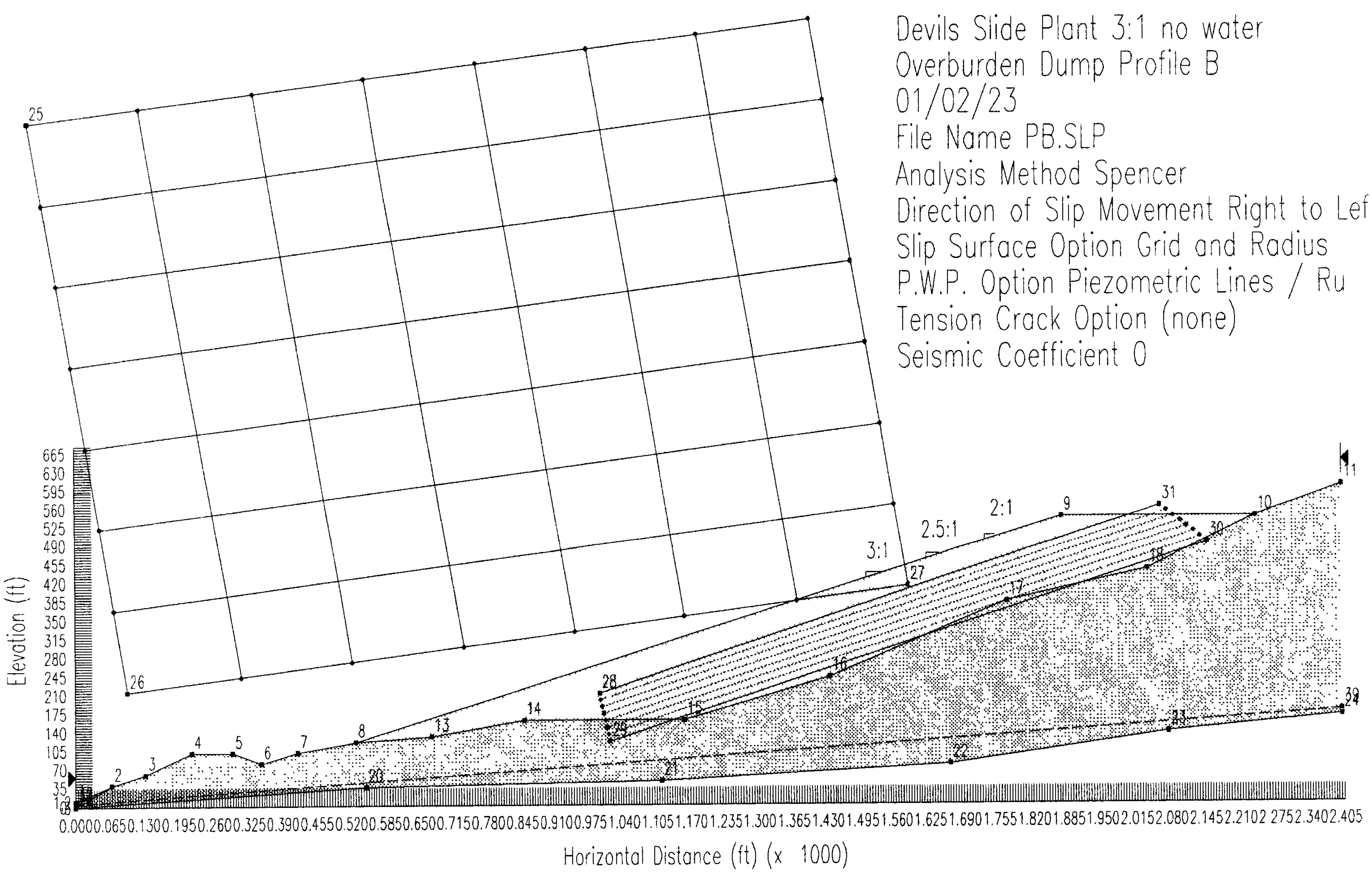


Devils Slide Plant 3:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
1.990
3:1
2.5:1
2:1
Elevation (ft)
665 630 595 560 525 490 455 420 385 350 315 280 245 210 175 140 105 70 35 0
0.000 0.065 0.130 0.195 0.260 0.325 0.390 0.455 0.520 0.585 0.650 0.715 0.780 0.845 0.910 0.975 1.040 1.105 1.170 1.235 1.300 1.365 1.430 1.495 1.560 1.625 1.690 1.755 1.820 1.885 1.950 2.015 2.080 2.145 2.210 2.275 2.340 2.405
Horizontal Distance (ft) (x 1000)



Devils Slide Plant 3:1
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
3:1
2.5:1
2:1
Elevation (ft)
665
630
595
560
525
490
455
420
385
350
315
280
245
210
175
140
105
70
35
Horizontal Distance (ft) (x 1000)


Devils Slide Plant 3:1 no water
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
1.990
3:1
2.5:1
2:1
665
630
595
560
525
490
455
420
385
350
315
280
245
210
175
140
105
70
35
0
Elevation (ft)
0.0000.0650.1300.1950.2600.3250.3900.4550.5200.5850.6500.7150.7800.8450.9100.9751.0401.1051.1701.2351.3001.3651.4301.4951.5601.6251.6901.7551.8201.8851.9502.0152.0802.1452.2102.2752.3402.405
Horizontal Distance (ft) (x 1000)

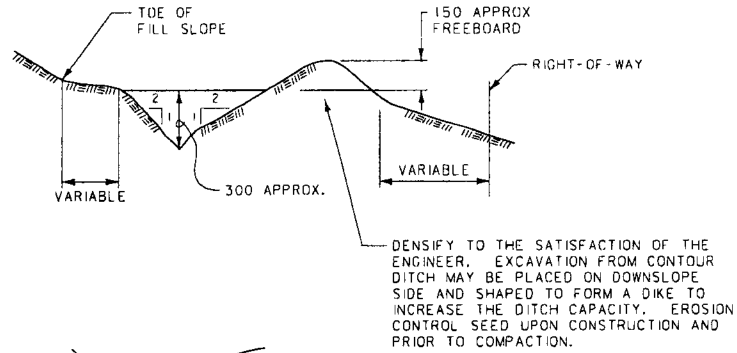


Devils Slide Plant 3:1 no water
Overburden Dump Profile B
01/02/23
File Name PB.SLP
Analysis Method Spencer
Direction of Slip Movement Right to Lef
Slip Surface Option Grid and Radius
P.W.P. Option Piezometric Lines / Ru
Tension Crack Option (none)
Seismic Coefficient 0
3:1
2.5:1
2:1
Elevation (ft)
665
630
595
560
525
490
455
420
385
350
315
280
245
210
175
140
105
70
35
0.0000.0650.1300.1950.2600.3250.3900.4550.5200.5850.6500.7150.7800.8450.9100.9751.0401.1051.1701.2351.3001.3651.4301.4951.5601.6251.6901.7551.8201.8851.9502.0152.0802.1452.2102 2752.3402.405
Horizontal Distance (ft) (x 1000)

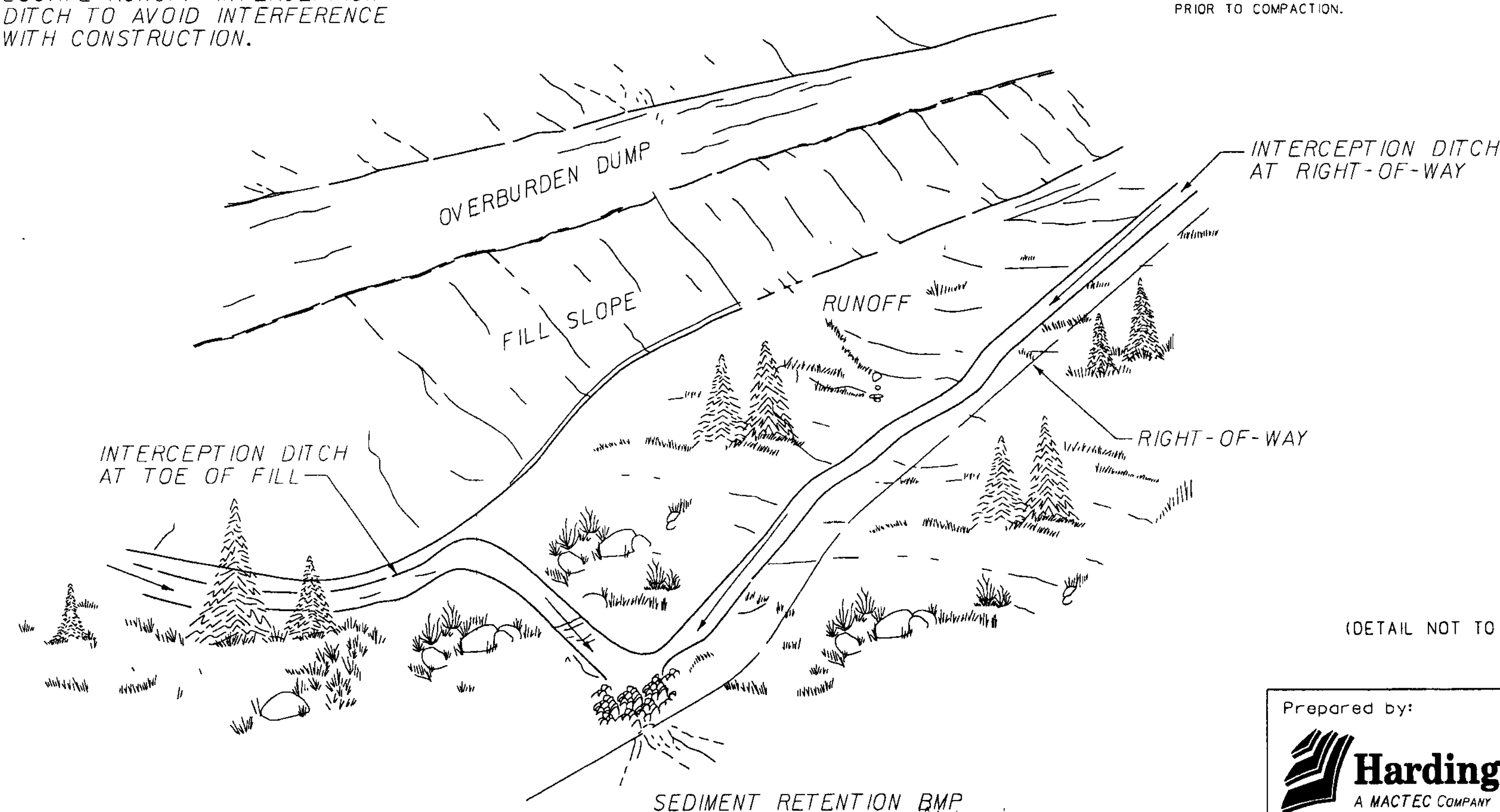
RUNOFF INTERCEPTION DITCH BMP R-07:

RUNOFF INTERCEPTION DITCHES (RID) INTERCEPT AND CONVEY SHEET FLOW RUNOFF TO SEDIMENT RETENTION BARRIERS. INTERCEPTED FLOWS PREVENT OFF-SITE DISCHARGE OF STORM WATER AND SEDIMENTATION.

USE RUNOFF INTERCEPTION DITCHES AT THE TOE OF SLOPES OR BETWEEN DISTURBED AREAS AND LIMITS OF OVERBURDEN DUMP TO PREVENT FLOWS FROM CARRYING SEDIMENT OFF-SITE. APPROPRIATE SUPPLEMENTS INCLUDE SLOPE DRAINS OR DITCH SEDIMENT TRAPS



NOTE:
LOCATE RUNOFF INTERCEPTION DITCH TO AVOID INTERFERENCE WITH CONSTRUCTION.



(DETAIL NOT TO SCALE)

Prepared by:

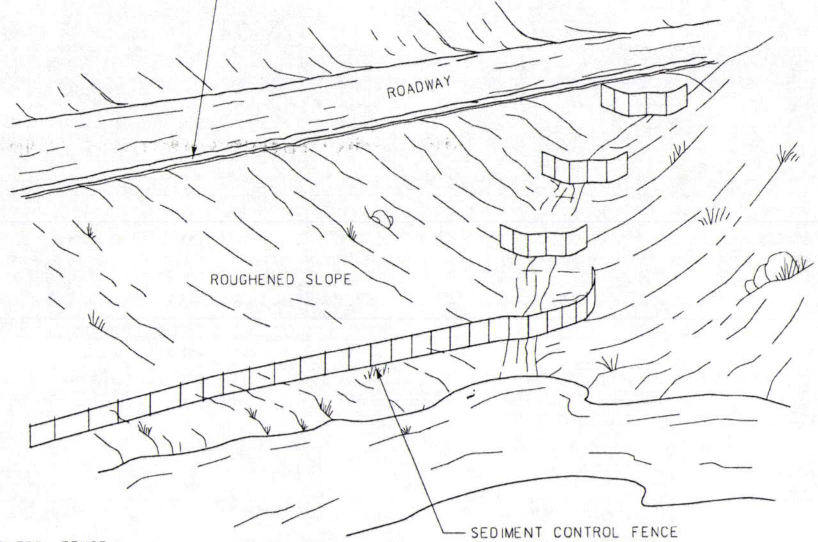
Harding ESE
A MACTEC COMPANY

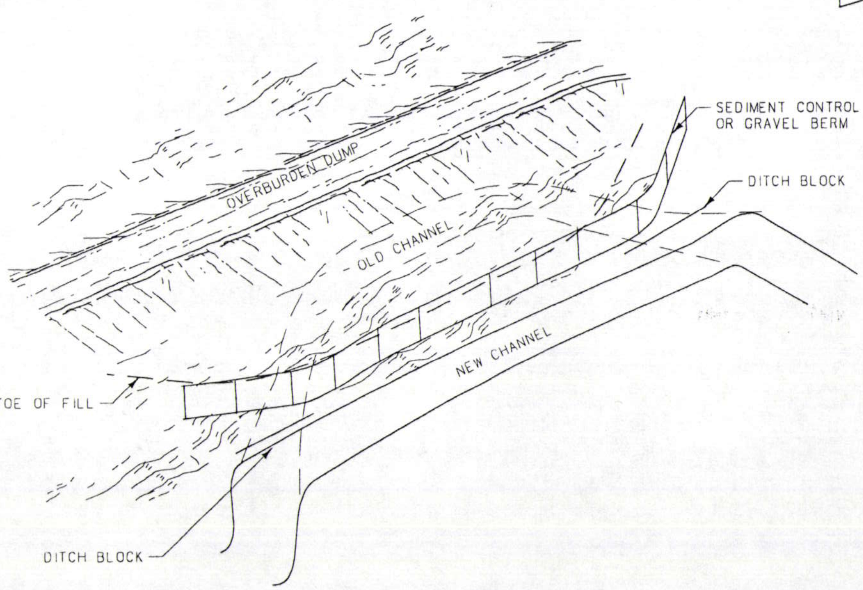
DETAILED DRAWING
RUNOFF INTERCEPTION DITCH
R647-4-107-OPERATING PRACTICES

WATER RESOURCE PROTECTION BMP W-02:

WATER RESOURCE PROTECTION (WR) IS EROSION CONTROL FOR CONSTRUCTION ACTIVITIES ADJACENT TO WATER RESOURCES. WATER RESOURCE PROTECTION APPLIES TO PERENNIAL STREAMS, WETLANDS, CHANNEL CHANGES, STREAM BANK DISTURBANCES, IRRIGATION SYSTEMS OR OTHER IMPACTS TO WATER RESOURCES FROM ROAD CONSTRUCTION. IT CAN BE USED FOR CRITICAL RESOURCES. THE DESIGNER DENOTES "CRITICAL RESOURCE" ON THE PLANS AND PUTS WATER RESOURCE PROTECTION WITH IT.

APPROPRIATE BMP FEATURES INCLUDE EROSION MAT, GRAVEL FILTER BERM, SEDIMENT CONTROL FENCE, STRAW BALE BARRIER OR VEGETATIVE BUFFER STRIP. ADDITIONAL BMP FEATURES INCLUDE SLOPE ROUGHENING, RUN-ON DIVERSION/ CONTROL, DITCH SEDIMENT TRAP, DUGOUT DITCH BASINS AND RUNOFF INTERCEPTION DITCH.





(DETAIL NOT TO SCALE)

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Harding ESE
A MACTEC COMPANY

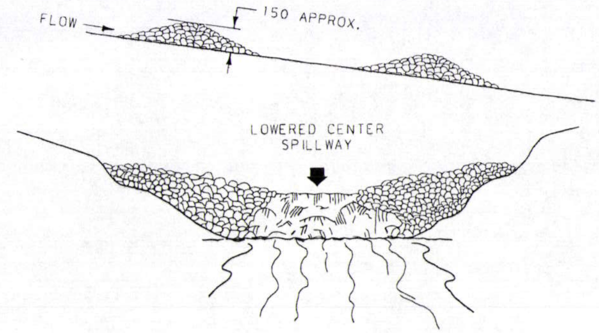
DETAILED DRAWING
WATER RESOURCE PROTECTION
R647-4-107-OPERATING PRACTICES

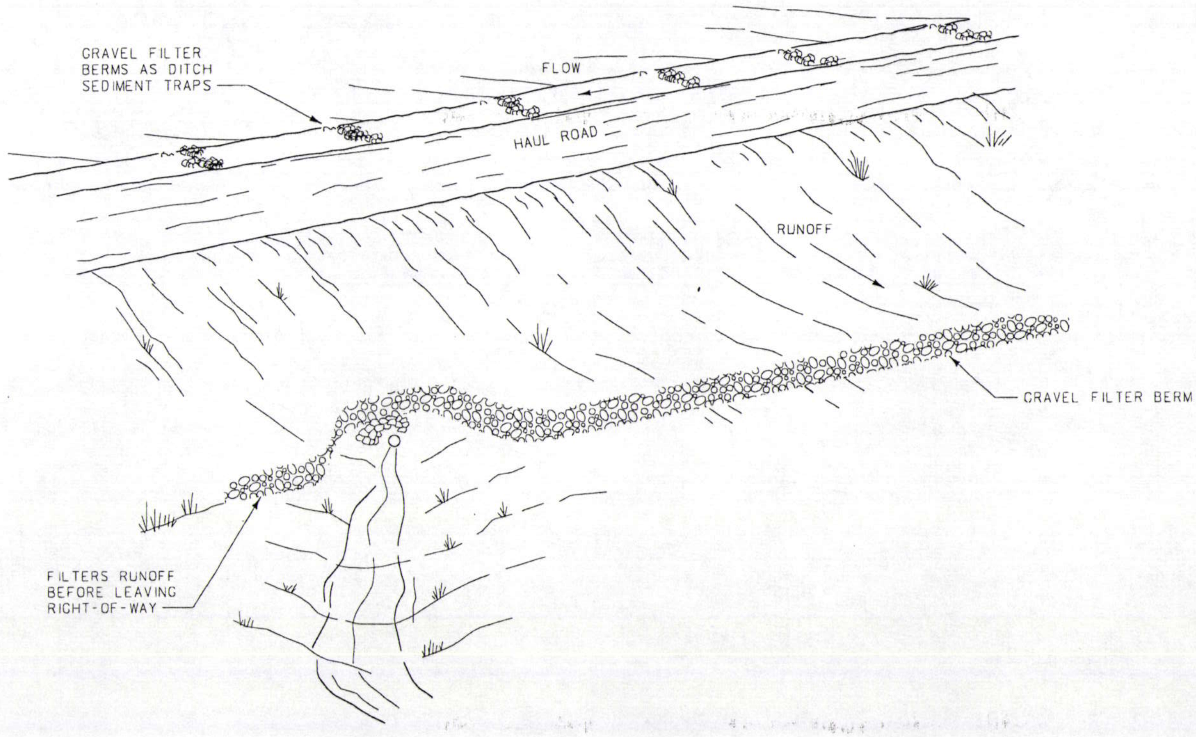
GRAVEL FILTER BERM BMP R-03:

GRAVEL FILTER BERMS (GFB) CONSIST OF A SINGLE OR SERIES OF GRAVEL BERMS TO REDUCE RUNOFF VELOCITIES AND RETAIN SEDIMENT. THE MAXIMUM HEIGHT FOR GRAVEL FILTER BERMS USED INSIDE THE CLEAR ZONE IS 150 mm.

BERM MATERIAL MUST BE 100% PASSING THE 50 mm SCREEN AND 10% MAXIMUM PASSING THE 4.75 mm SIEVE. BERM MATERIAL MAY BE PITRUN OR CRUSHED AGGREGATE.

GRAVEL FILTER BERMS ARE USED FOR SHEET OR CONCENTRATED FLOWS TO REDUCE RUNOFF VELOCITY, PROMOTE SEDIMENT RETENTION AND ALLOW SETTLING. APPLICATIONS INCLUDE DITCH SEDIMENT TRAPS, INLET/OUTLET PROTECTION AND TOE OF SLOPE PROTECTION. AS A DITCH SEDIMENT TRAP, THE END OF THE BARRIER MUST EXTEND A SUFFICIENT DISTANCE TO PREVENT END CUTTING. POSITION THE BARRIER TO PREVENT SEDIMENT FROM ENTERING DRAINAGE. DO NOT PLACE THE BARRIER ACROSS LIVE STREAMS. REMOVE SEDIMENT FROM BEHIND THE BERM WHEN IT ACCUMULATES TO ONE-HALF THE ORIGINAL HEIGHT UNLESS ITS DRAINAGE AREA HAS BEEN STABILIZED.





(DETAIL NOT TO SCALE)

Prepared by:

Harding ESE
A MACTEC COMPANY

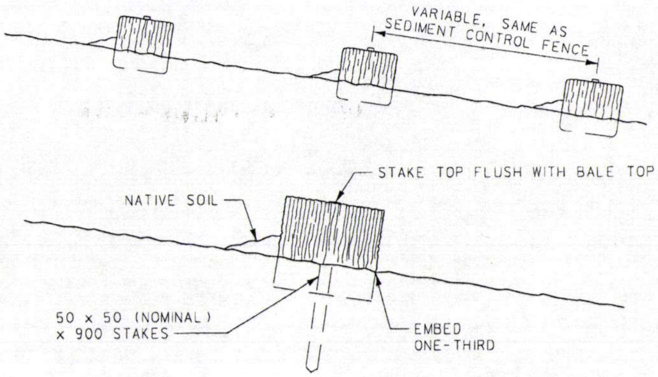
DETAILED DRAWING
GRAVEL FILTER BERM
R647-107-OPERATING PRACTICES

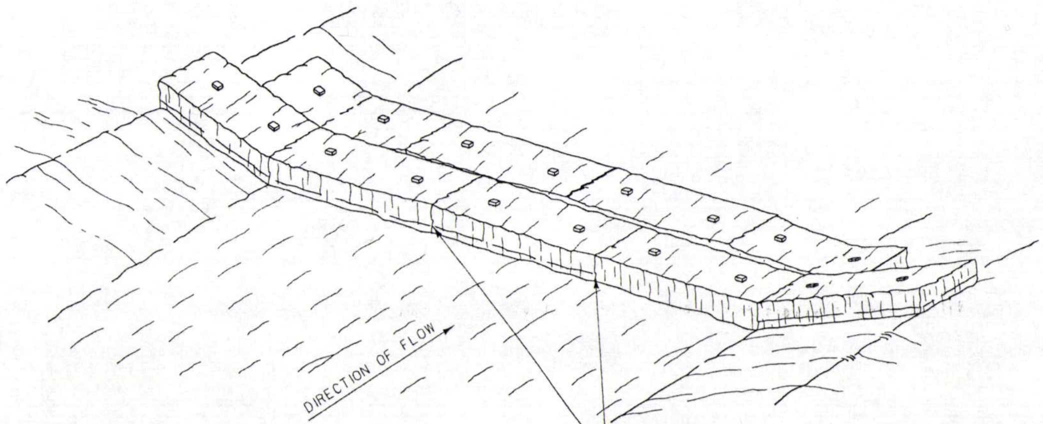
STRAW BALE BARRIER BMP R-05:

STRAW BALE BARRIER (SBB) IS A SEDIMENT BARRIER CONSISTING OF ENTRENCHED, OVERLAPPING AND ANCHORED STRAW BALES TO REDUCE RUNOFF VELOCITIES AND RETAIN SEDIMENT. DO NOT USE STRAW BALE BARRIERS INSIDE THE CLEAR ZONE. STRAW BALES MUST BE CERTIFIED WEED-FREE.

STRAW BALE BARRIERS ARE USED FOR SHEET OR CONCENTRATED FLOWS TO REDUCE RUNOFF VELOCITY, PROMOTE SEDIMENT RETENTION AND ALLOW SETTLING. ENTRENCH THE BARRIER APPROXIMATELY ONE-THIRD OF THE BALE'S HEIGHT AND BACKFILL ON THE UPHILL SIDE. USE 50 mm BY 50 mm (NOMINAL) BY 900 mm LONG WOODEN STAKES. DO NOT USE METAL STAKES. USE A MINIMUM OF TWO STAKES PER BALE.

AS A DITCH SEDIMENT TRAP, EXTEND THE END OF THE BARRIER TO SUCH AN EXTENT THAT THE BOTTOMS OF THE END BALES ARE HIGHER THAN THE TOPS OF THE LOWEST CENTER BALES. POSITION THE BARRIER TO PREVENT SEDIMENT FROM ENTERING THE DRAINAGE. DO NOT PLACE THE BARRIER ACROSS LIVE STREAMS. REPAIR OR REPLACE DAMAGED, UNDER-CUT OR END RUN BALES. APPLICATIONS INCLUDE (OUTSIDE THE CLEAR ZONE) DITCH SEDIMENT TRAPS, INLET/OUTLET PROTECTION, BANK PROTECTION AND TOE OF SLOPE PROTECTION.





DO NOT USE
WITHIN THE
CLEAR ZONE.

(DETAIL NOT TO SCALE)

Prepared by:

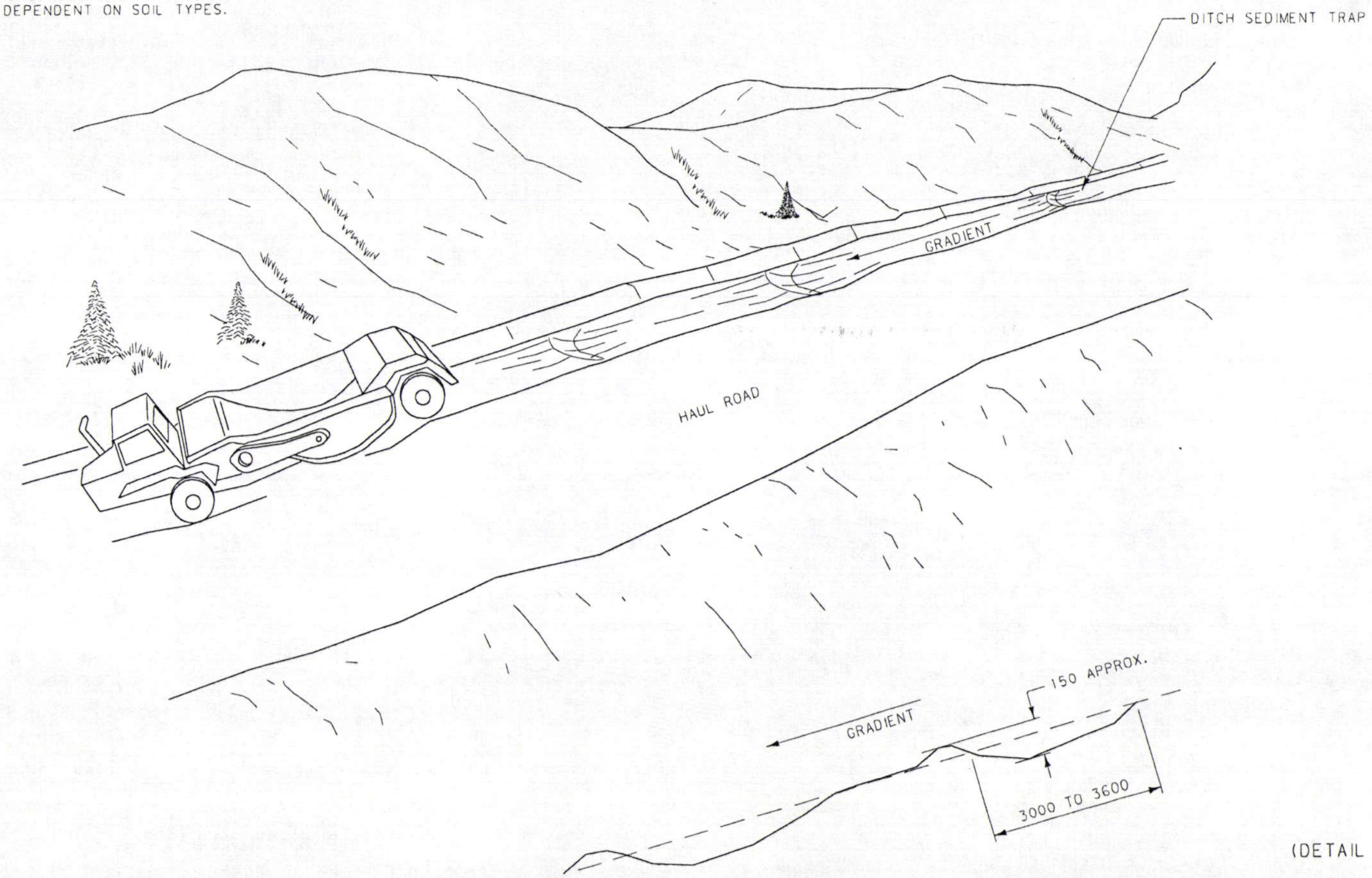
Harding ESE
A MACTEC COMPANY

DETAILED DRAWING
STRAW BALE BARRIER
R647-4-107-OPERATING PRACTICES

DUGOUT DITCH BASIN BMP R-02:

DUGOUT DITCH BASINS (DDB) CONSIST OF ONE OR A SERIES OF SMALL DUGOUT BASINS USED FOR CONCENTRATED FLOWS TO REDUCE RUNOFF VELOCITY, PROMOTE SEDIMENT RETENTION AND ALLOW SETTLING. THE MAXIMUM HEIGHT FOR DUGOUT DITCH BASINS USED INSIDE THE CLEAR ZONE IS 150 mm.

DUGOUT DITCH BASINS ARE USED FOR LONGITUDINAL SLOPE STEEPNESS (GRADE) SEDIMENT RETENTION. APPLICATIONS INCLUDE DITCH SEDIMENT TRAPS, INTERCEPTOR DITCHES AND TOE OF SLOPE PROTECTION. DISTANCES BETWEEN DUGOUT DITCH BASINS ARE SHOWN ON DTL. DWG. NO. 208-35 FOR USE IN DITCH SEDIMENT RETENTION. USE ON SLOPES IS DEPENDENT ON SOIL TYPES.



(DETAIL NOT TO SCALE)

Prepared by:

Harding ESE
A MACTEC COMPANY

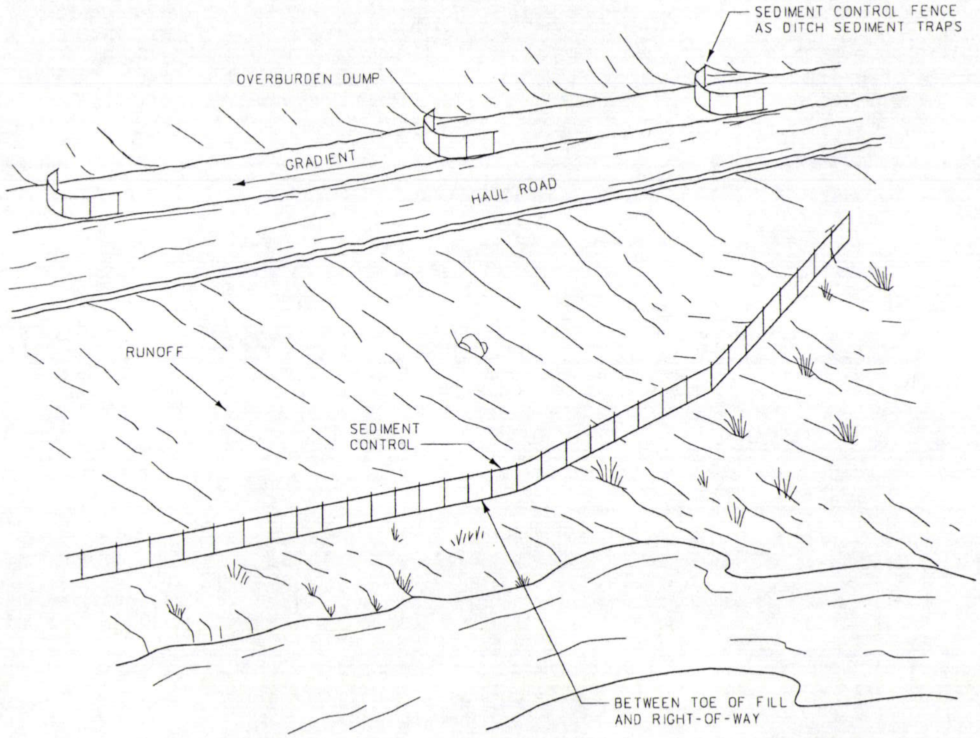
DETAILED DRAWING
DUGOUT DITCH BASIN
R647-4-107-OPERATING PRACTICES

SEDIMENT CONTROL FENCE BMP R-04:

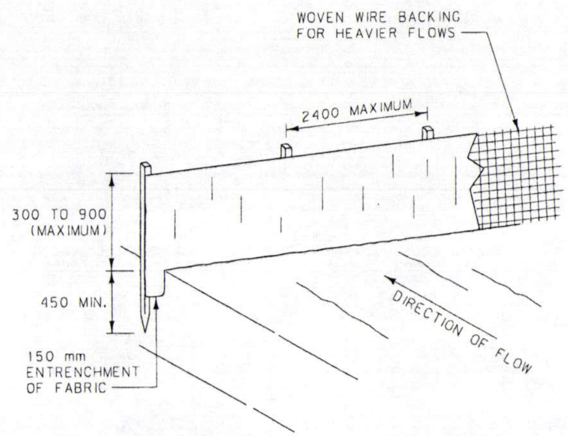
SEDIMENT CONTROL FENCE (SCF) IS A SINGLE OR SERIES OF FILTER FABRIC SEDIMENT BARRIER STRETCHED AND ATTACHED TO SUPPORTING POSTS. THE FENCE BOTTOM IS ENTRENCHED.

SEDIMENT CONTROL FENCES ARE USED FOR SHEET OR CONCENTRATED FLOWS TO ASSIST IN SEDIMENT CONTROL BY RETAINING SOME OF THE ERODED SOIL PARTICLES AND SLOWING THE RUNOFF VELOCITY TO ALLOW PARTICLE SETTLING. APPLICATIONS INCLUDE DITCH SEDIMENT TRAPS, WATER RESOURCE PROTECTION, INLET/OUTLET PROTECTION, BANK PROTECTION, TOE OF SLOPE PROTECTION AND CHANNEL CHANGES. INSTALL SEDIMENT CONTROL FENCES PRIOR TO DISTURBING AREAS REQUIRING THIS BMP OR AS SLOPE GRADES ARE ACHIEVED. MAXIMUM CUT OR FILL SLOPE FOR A SEDIMENT CONTROL FENCE IS 2:1. USE 50 mm BY 50 mm (NOMINAL) WOODEN STAKES. DO NOT USE METAL STAKES.

SEDIMENT CONTROL FENCES ARE USED BETWEEN THE EDGE OF OVERBURDEN DUMP DISTURBANCE AND A WATER RESOURCE. IN DITCHES AND SWALES THE ENDS OF THE FENCE CURVE UPSTREAM TO PREVENT FLOW FROM BY-PASSING THE FENCE. POSITION THE BARRIER TO PREVENT SEDIMENT FROM ENTERING THE DRAINAGE. DO NOT PLACE THE BARRIER ACROSS LIVE STREAMS. WOVEN WIRE BACKING IS NECESSARY WHEN DEALING WITH HEAVIER FLOW VELOCITIES AND SEDIMENT OR AS A ROCK BARRIER. DISTANCES BETWEEN SEDIMENT CONTROL FENCES ARE SHOWN ON DTL. DWG. NO. 208-35 FOR USE IN DITCH SEDIMENT RETENTION. REMOVE SEDIMENT FROM BEHIND THE FENCE WHEN IT ACCUMULATES TO ONE-THIRD THE ORIGINAL HEIGHT. EITHER GRADE AND SEED OR REMOVE THE SEDIMENT DEPOSITS PRIOR TO REMOVAL OF THE FENCE.



DITCH SEDIMENT TRAPS & PROTECTION OF LIVE STREAM



SILT FENCE CONSTRUCTION

(DETAIL NOT TO SCALE)

Prepared by:

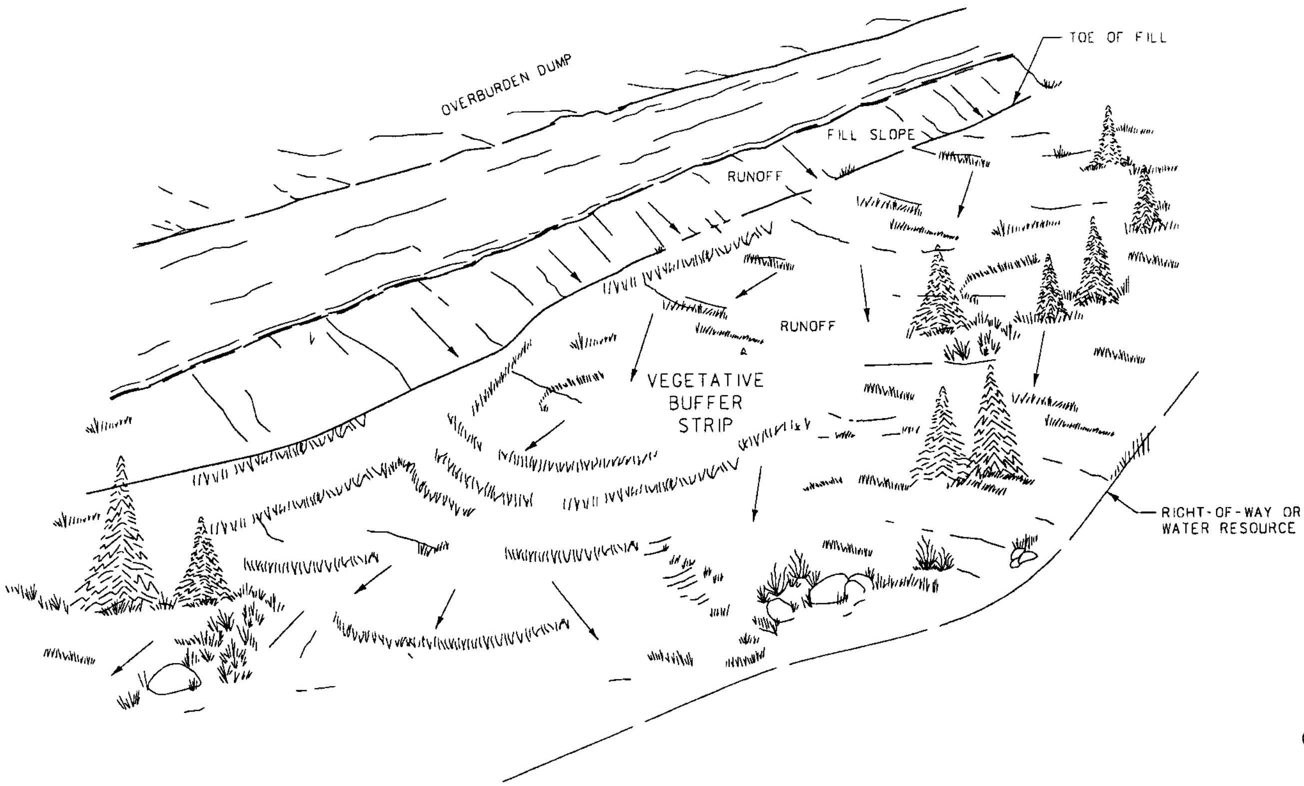
Harding ESE
A MACTEC COMPANY

DETAILED DRAWING
SEDIMENT CONTROL FENCE
R647-4-107-OPERATING PRACTICES

VEGETATIVE BUFFER STRIP BMP R-06.

VEGETATIVE BUFFER STRIP (VBS) IS AN UNDISTURBED AREA OR STRIP OF ESTABLISHED NATURAL VEGETATION. A VEGETATIVE BUFFER STRIP PROVIDES A LIVING SEDIMENT FILTER TO REDUCE RUNOFF VELOCITIES AND ALLOW CAPTURE AND SETTLING OF COARSE-GRAINED SEDIMENT. VEGETATIVE BUFFER STRIPS REDUCE OR PREVENT SEDIMENTATION FROM LEAVING THE OVERBURDEN DUMP.

IDENTIFY VEGETATIVE BUFFER STRIPS WITH FLAGGING BEFORE SOIL STRIPPING OCCURS. KEEP EQUIPMENT AND FILL MATERIAL OFF OF VEGETATIVE BUFFER STRIPS. ALWAYS CONSIDER VEGETATIVE BUFFER STRIPS WHEN WATER RESOURCES ARE ADJACENT TO OR NEAR DISTURBANCES AND REQUIRE PROTECTION. THE MINIMUM WIDTH REQUIREMENT FOR A WELL-ESTABLISHED VEGETATIVE STRIP WITH A SLOPE OF 3:1 OR FLATTER IS 15 m. THE MINIMUM WIDTH REQUIREMENT FOR A WELL-ESTABLISHED VEGETATIVE STRIP WITH A SLOPE STEEPER THAN 3:1 IS 30 m. APPROPRIATE SUPPLEMENTS INCLUDE GRAVEL BERMS, SEDIMENT CONTROL FENCES AND OTHER SEDIMENT RETENTION BARRIERS.



(DETAIL NOT TO SCALE)

Prepared by:

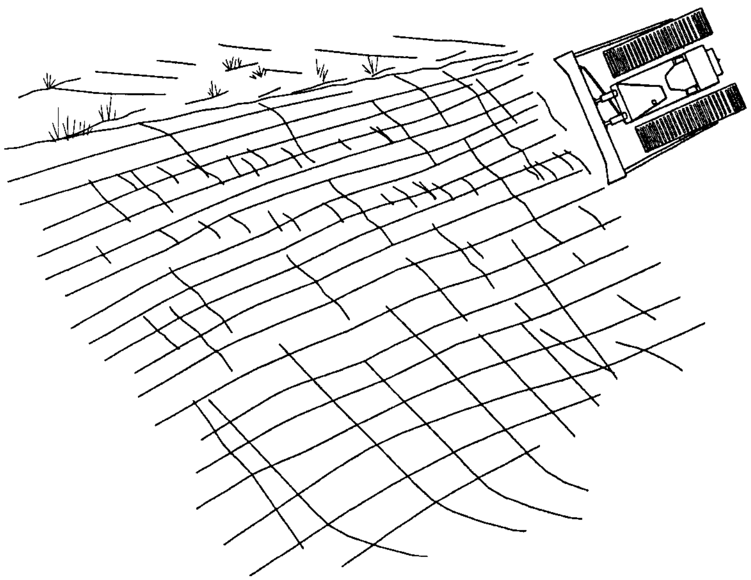
Harding ESE
A MACTEC COMPANY

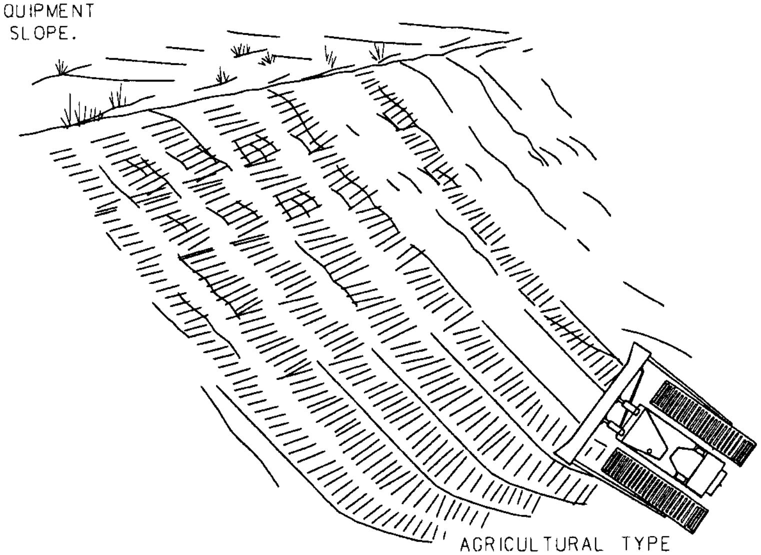
DETAILED DRAWING
VEGATATIVE BUFFER STRIP
R647-4-107-OPERATING PRACTICES

SLOPE ROUGHENING:

SLOPE ROUGHENING IS A VERY ROUGH SOIL SURFACE ON SLOPES RESULTING FROM CONSTRUCTION ACTIVITIES OR THE SYSTEMATIC ROUGHENING USING HEAVY EQUIPMENT TO CREATE RIDGES OR FURROWS PERPENDICULAR TO THE SLOPE. THE RIDGES OR FURROWS ARE TO BE EQUAL TO OR GREATER THAN 2 INCHES IN HEIGHT AND NO FURTHER THAN TWICE THE HEIGHT OF THE RIDGE OR FURROW APART. SLOPE ROUGHENING IS THE BEST FIRST LINE OF DEFENSE TO CONTROL EROSION AND SEDIMENT RUNOFF. DEGREE OF SLOPE ROUGHENING IS DEPENDENT ON THE GRADES AND PROXIMITY TO WATER RESOURCES.

ALL SLOPES STEEPER THAN 3:1 AND GREATER THAN 5 VERTICAL FEET REQUIRE SLOPE ROUGHENING, EXCLUDING ROCK SLOPES THAT CANNOT BE EXCAVATED BY RIPPING. APPROPRIATE SUPPLEMENTS INCLUDE TEMPORARY SEEDING OR EROSION SEEDING. WHEN FILL SLOPES ARE WITHIN 50 FEET OF SURFACE WATER, SEDIMENT RETENTION IS REQUIRED (SEDIMENT CONTROL FENCES OR RUNOFF INTERCEPTION DITCHES).





(DETAIL NOT TO SCALE)

Prepared by:

Harding ESE
A MACTEC COMPANY

DETAILED DRAWING
SLOPE ROUGHENING
R647-4-107-OPERATING PRACTICES

LOCATION ST. MARYS UT
Established Series
Rev. JLH/LW/MEO/AJE
9/92

ST. MARYS SERIES

The St. Marys series consists of well drained, moderately permeable soils that were formed in residuum and colluvium mainly from red conglomerate composed of quartzite, sandstone, and limestone cemented by red material that is softer than other components. These soils are on south, east, and west facing slopes of mountains. Slopes are 6 to 70 percent. The mean annual temperature is about 42 degrees F., and the average annual precipitation is 23 inches.

TAXONOMIC CLASS: Loamy-skeletal, mixed, frigid Typic Haploxerolls

TYPICAL PEDON: St. Marys gravelly loam, rangeland. (Colors are for dry soil unless otherwise noted.)

All--0 to 9 inches; brown (7.5YR 4/3) gravelly loam, dark brown (7.5YR 3/2) moist; weak very fine granular structure; soft, very friable, slightly sticky; many fine and few medium roots; neutral (pH 6.8); clear wavy boundary. (7 to 10 inches thick)

A12--9 to 18 inches; brown (7.5YR 4/3) very cobbly fine sandy loam, dark brown (7.5YR 3/2) moist; weak very fine granular structure; soft, very friable, slightly sticky; common fine and few medium roots; neutral (pH 7.2); clear irregular boundary. (5 to 10 inches thick)

B2--18 to 26 inches; red (2.5YR 5/6) very cobbly heavy fine sandy loam, reddish brown (2.5YR 4/4) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky, common fine and few medium roots; slightly calcareous, mildly alkaline (pH 7.6); gradual irregular boundary. (8 to 14 inches thick)

C--26 to 50 inches; red (2.5YR 5/8) very cobbly heavy fine sandy loam, red (2.5YR 4/6) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky; few fine roots; calcareous; mildly alkaline (pH 7.8).

TYPE LOCATION: Salt Lake County, Utah; about 550 feet northwest along an azimuth of 25 degrees north from the top of Big Mountain; about 2,450 feet south and 750 feet east of the NW corner of sec. 6, T.lN., R.3E.

RANGE IN CHARACTERISTICS: The mollic epipedon is 9 to 20 inches thick. Depth to bedrock ranges from 40 to more than 60 inches. Coarse fragments are cobblestones, pebbles, and rounded stones that remain after the red calcareous cementing agent of the conglomerate rock has weathered away. Mean annual soil temperature is 41 to 47 degrees F., and mean summer soil temperature is 59 to 67 degrees F.

The Al horizon has dominant hue of 7.5YR or 5YR (but some are 10YR), value of 3 through 5 dry, 2 or 3 moist, and chroma of 2 or 3. This horizon is soft or slightly hard, and slightly acid or neutral.

The B2 horizon has hue of 2.5YR or 5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 3 through 6. It ranges from very cobbly or very gravelly fine sandy loam to very cobbly or very gravelly loam that contains 35 to 85 percent coarse fragments. This horizon has weak, fine or medium subangular blocky structure. It is slightly acid to moderately alkaline, and noncalcareous to moderately calcareous.

The C horizon has hue of 2.5YR, 5YR or 7.5YR, value of 3 through 6 dry and 3 through 5 moist, chroma of 4 through 8. It ranges from very cobbly or very gravelly fine sandy loam to very gravelly or very cobbly sandy clay loam and has 40 to 85 percent rock fragments.

The C horizon is slightly acid to moderately alkaline, and noncalcareous to moderately calcareous.

COMPETING SERIES: These are Bradshaw, Burgi, Fuego, Gappmayer, Kilburn, Knutsen, Mud Springs and Poleline series. Bradshaw soils have hue of 10YR or 7.5YR in the B horizon. Burgi and Poleline soils have mollic epipedons more than 20 inches thick. Fuego and Mud Springs soils have bedrock at depths of less than 40 inches. Gappmayer soils have albic horizons and very cobbly argillic horizons. Kilburn and Knutsen soils have hue of 2.5Y, 10YR, or 7.5YR in the B horizons and mean annual temperature of 47 to 54 degrees F. Also, Knutsen soils have less than 35 percent by volume of coarse fragments in the control section.

GEOGRAPHIC SETTING: St. Marys soils are on south, east and west facing slopes of mountains at elevations of 5,500 to 8,500 feet. Slope gradients range from 6 to 70 percent. These soils formed in residuum and colluvium mainly from red conglomerate composed of quartzite, sandstone, and limestone cemented by red material that is softer than other components. The climate is moist subhumid. The mean annual temperature ranges from 39 to 45 degrees F., the mean summer temperature from 55 to 65 degrees F., and the mean annual precipitation from 18 to 26 inches.

PRINCIPAL ASSOCIATED SOILS: These are the Foxol, Guilder, Henefer, Hoskin, Lucky Star, Moweba and Wallsburg soils. Foxol soils have bedrock at depths of less than 20 inches. Guilder soils lack mollic epipedons and have heavy clay loam argillic horizons. Henefer soils have argillic horizons that contain more than 35 percent clay and less than 20 percent coarse fragments. Hoskin soils have argillic horizons and have bedrock at depths of 20 to 40 inches. Lucky Star soils have albic and argillic horizons, the upper boundaries of the B2t horizons are at depths of more than 24 inches, and the mean summer temperature is less than 59 degrees F. Moweba soils have mollic epipedons more than 20 inches thick. Wallsburg soils have argillic horizons that contain more than 35 percent clay, and bedrock is at depths of less than 20 inches.

DRAINAGE AND PERMEABILITY: Well drained; medium to rapid runoff; moderate to moderately rapid permeability.

USE AND VEGETATION: Used for summer range, wildlife and watershed. Vegetation is big sagebrush, snowberry, ninebark, wheatgrass, fescue and annuals, with oakbrush and widely spaced small aspen in some places.

DISTRIBUTION AND EXTENT: Northern Utah. The series is moderately extensive.

MLRA OFFICE RESPONSIBLE: Lakewood, Colorado

SERIES ESTABLISHED: Salt Lake Area, Utah, 1941.

REMARKS: These soils were formerly classified as Brunizems.

OSED scanned by NSSQA. Last revised by state 11/74.

LOCATION HOSKIN UT+CA ID

Established Series
Rev. AJE/JMW
9/92

HOSKIN SERIES

Typically, Hoskin soils have brown, neutral, cobbly loam A horizons; brown, neutral, very cobbly heavy loam B2t horizons and brown, neutral, very cobbly loam C horizons over conglomerate or sandstone at a depth of 28 inches.

TAXONOMIC CLASS: Loamy-skeletal, mixed, frigid Typic Argixerolls

TYPICAL PEDON: Hoskin cobbly loam - native grasses and shrubs. (Colors are for dry soil unless otherwise noted.)

Al--0 to 7 inches; brown (7.5YR 4/3) cobbly loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, friable, nonsticky and slightly plastic; many fine and medium and large roots; 40 percent gravel and cobbles; neutral (pH 6.8); clear wavy boundary. (7 to 19 inches thick)

B2t--7 to 16; brown (7.5YR 5/4) very cobbly heavy loam, dark brown (7.5YR 3/4) moist; weak medium subangular blocky structure that parts to weak fine subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; many fine and medium roots; many fine pores; common thin clay films; 60 Percent gravel and cobbles; neutral (pH 7.0); gradual wavy boundary. (8 to 25 inches thick)

C--6 to 28 inches; brown (7.5YR 5/4) very cobbly loam, dark brown (7.5YR 4/4) moist; massive; soft, friable, nonsticky and slightly plastic; few fine and medium roots; many fine pores- soil matrix is noncalcareous with lime on underside of coarse fragments; 80 percent cobbles and stones; neutral (pH 6.8).

R--28 to 32 inches; weathered consolidated conglomerate.

TYPE LOCATION: Cache County, Utah; 6 1/2 miles south and 1 mile west of Hardware Ranch; 100 feet west and 100 feet south of the NE corner or sec. 21, T.9N., R.3E.

RANGE IN CHARACTERISTICS: The mollic epipedon ranges from 7 to 20 inches thick. The combined thickness of the Al and B2t horizons ranges from 15 to 39 inches. Weathered bedrock is at depths of 22 to 40 inches. Coarse fragments are mainly cobble and gravel size rounded or slightly angular andesite, quartzite or sandstone rock fragments ranging from 20 to 50 percent in the Al horizons and 35 to 80 percent in the B2t and C horizons. The mean annual soil temperature ranges from 39 to 43 degrees F., the mean summer temperature at a depth of about 20 inches ranges from 60 to 65 degrees F. The soils are moist for 55 to 65 percent of the time but are dry for 60 to 75 consecutive days in the summer and autumn in the 8 to 24 inch section. The cation exchange capacity/clay ratio is about 1.0 to 1.4. Base saturation is more than 75 percent throughout the upper 30 inches.

The Al horizon has hue of 10YR, 7.5YR or 5YR, value of 3 through 5 dry, 2 or 3 moist, and chroma of 2 or 3. It is neutral or slightly acid.

The B2t horizon has hue of 7.5YR, 5YR or 2.5YR, value of 4 or 5 dry, 3 or 4 moist, and chroma of 3 through 6. The soil has moist value of 4, chroma of 4 or contains less than 1 percent organic matter below depth of 20 inches. The B2t horizon is cobbly or very cobbly sandy clay loam or clay loam, or very cobbly heavy loam. It has continuous moderately thick to few thin clay films. This horizon has weak to moderate, fine to coarse subangular blocky structure. It ranges from mildly alkaline to medium acid and is 8 to 25 inches thick.

The C horizon has hue of 7.5YR, 5YR or 10YR, value of 4 through 6 dry, 3 or 4 moist, and chroma of 4 through 6. It is very cobbly loam, very cobbly sandy loam, or very gravelly loam. This horizon is slightly acid to mildly alkaline.

COMPETING SERIES: These are the Agassiz, Bradshaw, Forsey, Holmes, Horrocks, Rasband, St. Marys, Stemilt, and Yeates Hollow series. Agassiz soils are less than 20 inches deep over fractured limestone. Bradshaw and St. Marys soils lack argillic horizons and have very gravelly sandy loam control sections. Forsey, Horrocks, and Stemilt soils are deeper than 40 inches to bedrock. Holmes soils have very gravelly light loam or very gravelly sandy loam argillic horizons with 10YR hue. Rasband soils have gravelly loam argillic horizons containing less than 35 percent gravel in the upper part of the control section. Yeates Hollow soils have very cobbly clay argillic horizons with more than 35 percent clay.

SETTING: Hoskin soils are at elevations of 5,300 to 8,000 feet above sea level on moderately sloping to very steep, dominantly south and west facing mountain slopes and terminal moraines. Slope gradients are 10 to 70 percent. these soils formed in residuum and colluvium from sandstone, quartzite, and conglomerate. The climate is moist subhumid with warm dry summers and temperature is 39 to 49 degrees F., mean summer temperature is 59 to 65 degrees E. The average annual precipitation is 18 to 27 inches, falling mostly as snow. Frost-free season is 70 to 90 days.

PRINCIPAL ASSOCIATED SOILS: These are the competing Agassiz soils and the Ant Flat, Charcol, Etchen, Henefer, Lucky Star, Moweba, Scave, Scout and St. Marys soils. Ant Flat soils have clay argillic horizons that are not gravelly or cobbly. Charcol soils have Al horizons more than 20 inches thick, A2 horizons, and the top of the argillic horizon is at depths below 40 inches of the surface. Etchen soils lack mollic epipedons. Henefer soils are more than 40 inches deep to bedrock and have less than 35 percent rock fragments in the control section. Lucky Star and Scave soils have albic horizons and have average summer temperature of less than 59 degrees F. Moweba soils have mollic epipedons more than 20 inches thick and lack argillic horizons. Scout soils lack both mollic epipedons and argillic horizons and have very gravelly sandy loam control sections. St. Marys soils lack argillic horizons.

DRAINAGE AND PERMEABILITY: Well drained or somewhat excessively drained; medium to rapid runoff; moderate to moderately rapid permeability.

USE AND VEGETATION: These soils are used mainly for watershed and for spring to fall grazing by livestock and wildlife. The native vegetation is bluebunch wheatgrass, bitterbrush, tall native bluegrass, prairie junegrass, slender wheatgrass, oniongrass, basin wildrye, balsamroot, buckwheat, herbaceous sage, big sagebrush, serviceberry, snowberry, and oakbrush.

DISTRIBUTION AND EXTENT: Mountain areas in northern Utah. This series is moderately extensive.

MLRA OFFICE RESPONSIBLE: Lakewood, Colorado

SERIES ESTABLISHED: Cache County, Utah, 1972.

REMARKS: The Hoskin soils were formerly classified as Brunizems.

OSED scanned by NSSQA. Last revised by state 11/74.

National Cooperative Soil Survey
U.S.A.

LOCATION HENEFER UT+ID

Established Series
Rev. RLT/VLP/MJD
07/1999

HENEFER SERIES

The Henefer series consists of very deep, well drained, slowly permeable soils. These soils formed in alluvium and colluvium from quartzite and sandstone on fan remnants, mountain toeslopes and mountain slopes. Slopes range from 1 to 60 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Fine, smectitic, frigid Pachic Argixerolls

TYPICAL PEDON: Henefer silt loam--rangeland. (Colors are for air-dry soil unless otherwise stated.)

Oi--0 to 1 inch; decomposing organic litter.

A1--1 to 4 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; neutral (pH 6.6); clear wavy boundary. (1 to 7 inches thick)

A2--4 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to fine subangular blocky; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; common fine and medium pores; slightly acid (pH 6.3); abrupt wavy boundary. (5 to 12 inches thick)

Bt1--13 to 21 inches; reddish brown (5YR 4/3) cobbly silty clay loam, dark reddish brown (5YR 3/3) moist; weak coarse subangular blocky structure parting to moderate fine subangular blocky; very hard, firm, sticky and very plastic; common fine and few medium roots; few fine pores; faint continuous clay films; thin to moderately thick gray coatings on most peds; 10 percent gravel, 10 percent cobbles; slightly acid (pH 6.2); clear wavy boundary. (8 to 15 inches thick)

Bt2--21 to 37 inches; reddish brown (5YR 5/3) cobbly clay, reddish brown (5YR 4/4) moist; weak coarse prismatic and moderate coarse subangular blocky structure parting to strong fine and medium angular blocky; extremely hard, very firm, sticky and very plastic; few fine roots; distinct continuous clay films; 10 percent gravel, 10 percent cobbles; moderately acid (pH 6.0); clear irregular boundary. (9 to 16 inches thick)

Bt3--37 to 49 inches; reddish brown (5YR 5/4) cobbly clay, reddish brown (5YR 4/4) moist; weak coarse prismatic structure parting to strong medium and fine angular blocky; extremely hard, extremely firm, very sticky and very plastic; few fine roots; prominent continuous clay films; 10 percent gravel, 15 percent cobbles; neutral (pH 6.7); clear wavy boundary. (12 to 16 inches thick)

BC--49 to 61 inches; reddish brown (5YR 5/4) very cobbly clay loam, reddish brown (5YR 4/4) moist; moderate fine angular blocky structure; very hard, firm, sticky and plastic; 25 percent gravel, 20 percent cobbles; neutral (pH 7.0).

TYPE LOCATION: Wasatch County, Utah; about 2 miles southwest of Wallsburg; east from Wallsburg Junction and U.S. Highway 189, towards Wallsburg for 3.1 miles, then south 2 miles on side road; 1,740 feet north and 520 feet east of southwest corner, sec. 24, T. 5 S., R. 4 E.

RANGE IN CHARACTERISTICS: (Depths given are measured from the mineral soil surface). The A and Bt horizons are more than 40 inches thick. The mollic epipedon is 20 inches or more thick. The particle-size control section averages 15 to 35 percent rock fragments and 35 to 50 percent clay. The soil is dry for 45 to 60 consecutive days in the four months following the summer solstice. The mean annual soil temperature is 44 to 47 degrees F, and the mean summer temperature is more than 60 degrees F.

The A horizon has hue of 7.5YR, 10YR, or 5YR, value of 3 to 5 dry and 2 or 3 moist, chroma of 2 or 3.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 3 to 6 dry, 2 to 4 moist, and chroma of 2 to 6. It ranges from gravelly or cobbly clay loam, silty clay loam or silty clay to gravelly or cobbly clay or to very gravelly or very cobbly clay, clay loam, or sandy clay loam in the lower part. This horizon is neutral to moderately acid.

The BC horizon has hue of 10YR, 7.5YR or 5YR, value of 4 to 7 dry, 3 to 6 moist, and chroma of 2 to 4. It ranges from silty clay, silty clay loam, clay loam, loam and sandy clay loam and contains 50 to 70 percent rock fragments. This horizon ranges from moderately acid to neutral.

A C horizon occurs below a depth of 50 inches in some pedons and typically contains about 50 to 80 percent rock fragments.

COMPETING SERIES: These are the Arcia (NV), Arva (NV), Broadhead, Cristo, Rugar, (NV), and Sweitberg (WA) series. Arcia, Cristo and Sweitberg soils are 20 to 40 inches deep to bedrock. Arva soils have a paralithic contact at 40 to 60 inches and do not include hues of 2.5YR or 5YR. Broadhead soils contain less than 15 percent coarse fragments in the Bt horizon. Rugar soils are mottled in the Bt horizon.

GEOGRAPHIC SETTING: Henefer soils are on fan remnants, toe slopes and mountain slopes at elevations of 5,200 to 8,400 feet. Slopes are from 1 to 60 percent. The soils formed in materials derived from mixed sedimentary rocks, mainly sandstone, shale, and argillite. The climate is moist subhumid with mean annual air temperature of 40 to 45 degrees F, average summer temperature of 56 to 64 degrees F, and an average annual precipitation of 16 to 25 inches. The freeze free period is 60 to 90 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Bradshaw, Durfee, Gappmayer, Horrocks, Moweba, Poleline, Rake, St. Mary's, Wallsburg and Yeates Hollow soils. Bradshaw, Durfee, Gappmayer, Horrocks, Poleline, Rake, St. Mary's and Yeates Hollow soils have more than 35 percent rock fragments in the particle-size control section. Moweba, Poleline and St. Mary's soils all lack argillic horizons. Rake soils are 12 to 20 inches deep over an indurated lime hardpan. Wallsburg soils are less than 20 inches deep over sandstone.

DRAINAGE AND PERMEABILITY: Well drained; medium to slow runoff; slow permeability.

USE AND VEGETATION: These soils are principally used for rangeland and watershed. Small acreages are cultivated on lower slopes. Native vegetation is bearded wheatgrass, mountain bromegrass, slender wheatgrass, and bluegrass. Forbs and browse plants are balsamroot, lupine, geranium, big sagebrush, oakbrush, snowberry, and birchleaf mountainmahogany.

DISTRIBUTION AND EXTENT: These soils are moderately extensive in the Wasatch Mountains of north-central Utah; MLRA 47.

MLRA OFFICE RESPONSIBLE: Lakewood, Colorado

SERIES ESTABLISHED: Heber Valley Area, Utah, 1972.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon (Pachic feature) - from 1 to 21 inches. (A1, A2, and Bt1 horizons)

Argillic horizon -the zone from approximately 13 to 49 inches. (Bt1, Bt2, Bt3 horizons)

Particle size control section - the zone from 13 to 33 inches.

Classification: Keys to Soil Taxonomy, Eighth Edition, 1998.

LOCATION KILFOIL UT
Established Series
Rev. EJ/JAC/AJE
9/92

KILFOIL SERIES

The Kilfoil series consists of moderately deep, well drained soils that formed in material weathered from sandstone and shale. They are on south-facing mountain slopes. The mean annual precipitation is about 21 inches and the mean annual temperature is about 40 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, frigid Mollic Haploxeralfs

TYPICAL PEDON: Kilfoil loam, rangeland. (Colors are for moist soil unless otherwise noted.)

All--O to 1 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak medium platy structure that parts to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; common very fine, fine and medium roots; many fine pores; mildly alkaline (pH 7.6); abrupt smooth boundary. (1 to 4 inches thick)

A12--1 to 3 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine, fine and medium roots; few very fine pores; 5 percent soft angular pebbles; slightly calcareous; mildly alkaline (pH 7.8); abrupt smooth boundary. (2 to 5 inches thick)

B21t--3to 7 inches; dark brown (10YR 3/3) light clay loam, pale brown (10YR 6/3) dry; moderate fine subangular blocky structure that parts to moderate medium granular; slightly hard; firm, sticky and slightly plastic; common very fine, fine and medium roots; few fine pores; common thin clay skins on faces of peds; 5 percent soft angular pebbles; slightly calcareous; moderately alkaline (pH 8.0); clear smooth boundary. (3 to 10 inches thick)

B22t--7 to 21 inches; dark brown (10YR 4/3) light clay loam, light yellowish brown (10YR 6/4) dry; weak coarse subangular blocky structure that parts to moderate medium subangular blocky; hard, firm, sticky and slightly plastic; few very fine, fine and medium roots; common fine, few coarse pores; common thin clay skins on faces of peds; 10 percent soft angular gravel; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.4); abrupt irregular boundary. (6 to 18 inches thick)

Cca--21 to 30 inches, yellowish brown (10YR 5/4) gravelly loam, very pale brown (10YR 7/3) dry; weak medium subangular blocky structure that parts to weak medium granular; soft, friable, slightly sticky and slightly plastic; few very fine and medium roots; common fine, few coarse pores; 35 percent soft angular gravel; moderately calcareous; lime is disseminated and veined; strongly alkaline (pH 8.6). (6 to 10 inches thick)

R--30 to 40 inches, weathered sandstone and shale bedrock.

Type Location: Morgan County, Utah; 4.5 miles east and 7 miles north of Croydon; 850 feet west and 2,500 feet south of the NE corner of sec. 13, T.5N., R.4E.

Range in Characteristics: The ochric epipedon ranges from 3 to 6 inches thick. The top of the Cca horizon is immediately below the B2t horizon and is at depths of 13 to 35 inches. Depth to fractured bedrock ranges from 21 to 40 inches. The mean annual soil temperature at depth of 20 inches ranges from 41 to 45 degrees F. The mean summer temperature ranges from 62 to 65 degrees F. The soils are usually moist, but are dry for 65 to 85 consecutive days during the summer. Rock fragments range from 0 to 15 percent in the Al horizon, 0 to 20 percent in the B2t horizon, and 10 to 70 percent in the Cca horizon. Rock fragments below the Al horizon consist of soft, angular fragments of sandstone and shale.

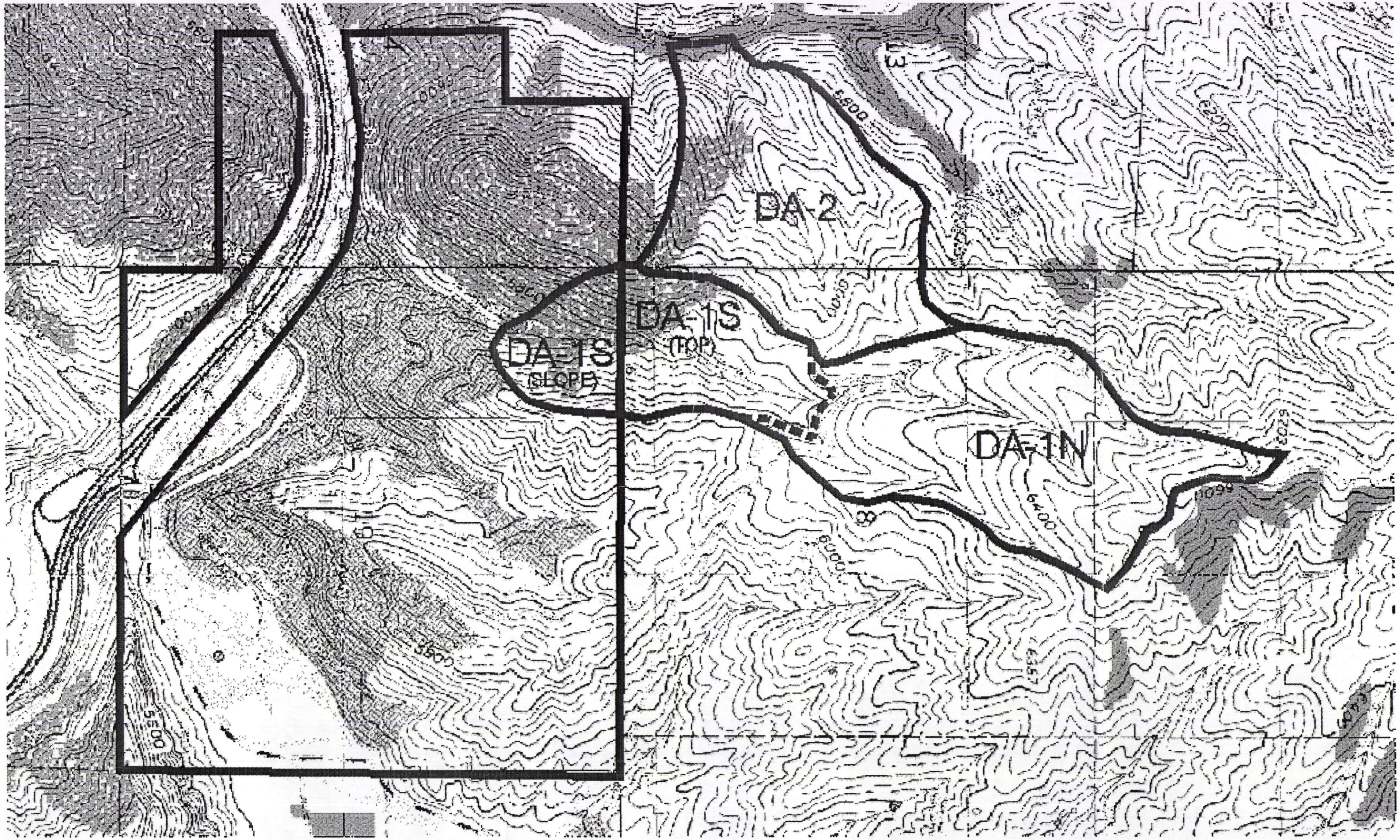
The Al horizon has hue of 10YR through 5Y, value of 4 through 6 dry, 2 through 4 moist, and chroma of 2 through 4 dry and moist. It ranges from loam to silt loam. This horizon is noncalcareous to moderately calcareous, neutral through strongly alkaline, and ranges from 3 to 6 inches thick.

The B2t horizon has hue of 10YR through 5Y, value of 5 through 7 dry, 4 or 5 moist, and chroma of 2 through 4 dry and moist. It ranges from light clay loam to silty clay loam, silt loam, or loam to cobbly sandy clay loam, or gravelly silt loam in some parts . Structure ranges from weak to moderate, very fine through coarse subangular blocky. Clay films are few to continuous, thin and few moderately thick. This horizon is slightly through strongly calcareous, mildly through strongly alkaline, and ranges from 8 to 19 inches thick.

The Cca horizon has hue of 10YR through 5Y, value of 5 through 7 dry, 4 or 5 moist, and chroma of 1 through 6 dry, 1 through 4 moist. It ranges from loam to gravelly or very cobbly loam, sandy clay loam, or very gravelly silt loam. This horizon ranges from moderately to strongly calcareous, and neutral through strongly alkaline.

COMPETING SERIES: These are the Bullnel and Neuske series. Bullnel soils have hue of 10R, 2.5YR or YR in the B2t horizon. Neuske soils have A2 horizons, are more than 40 inches deep and have bisequum profiles.

GEOGRAPHIC SETTING: Kilfoil soils are at elevations of 5,500 to 7,700 feet. They occur on south-facing even or convex mountain slopes. Slopes ranges from 25 to 60 percent. these soils formed in residuum and local alluvium weathered from sandstone and shale. The climate is moist subhumid, and the average annual precipitation ranges from 18 to 25 inches. The mean annual temperature is 39 to 41 degrees F. The mean summer temperature is 59 to 61 degrees F., and the frost-free period ranges from 70 to 80 days.
ASSOCIATED SOILS: These are the Croydon, Hades, Isbell, Moweba and St. Marys soils. All of these soils are more- than 40 inches deep to bedrock. Croydon soils have mean summer temperatures less than 59 degrees F. Hades soils have mollic epipedons more than 20 inches thick. Isbell soils have mollic epipedons. Moweba soils have mollic epipedons more than 20 inches thick and loamy-skeletal control sections. St. Marys soils have mollic epipedons and loamy-skeletal control sections.
DRAINAGE AND PERMEABILITY: Well drained; medium runoff; moderate permeability above the bedrock.
USE AND VEGETATION: These soils are used for watershed, range, and wildlife habitat. The present native vegetation is big sagebrush, Gambel oak, serviceberry, basin wildrye, balsamroot and bluebunch wheatgrass.
DISTRIBUTION AND EXTENT: These soils occur in northern Utah. This series is inextensive.
MLRA OFFICE RESPONSIBLE: Lakewood, Colorado
SERIES ESTABLISHED: Horgan Area, Horgan County, Utah, 1974.
OSED scanned by NSSQA. Last revised by state 11/74.



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SCALE: 1" = 1000'

Harding ESE A MACTEC COMPANY	Project: DUMP EXPANSION DRAINAGE AREAS HOLNAM DEVIL'S SLIDE MINE DEVIL'S SLIDE, UTAH MAP R647-4-111.2a		
Prepared For: HOLNAM	Drawn: SJE	Horiz. Scale 1"=1000'	Vert. Scale
	Checked: MGR	Proj. No. 50963	REV.
		SHEET NO. 1 OF 1	

This page is a reference page used to track documents internally for the Division of Oil, Gas and Mining

Mine Permit Number M0290001 Mine Name Devils Slide
Operator Ideal Basic IND. Inc. Date June 7, 2001
TO ____________________ FROM ____________________

__CONFIDENTIAL __BOND CLOSURE __LARGE MAPS X EXPANDABLE
__MULTIPUL DOCUMENT TRACKING SHEET __NEW APPROVED NOI
__AMENDMENT _OTHER____________________

Description YEAR-Record Number

__NOI X Incoming __Outgoing __Internal __Superceded

Application to Revise Large Mining operations

__NOI __Incoming __Outgoing __Internal __Superceded

__NOI __Incoming __Outgoing __Internal __Superceded

__NOI __Incoming __Outgoing __Internal __Superceded

__TEXT/ 81/2 X 11 MAP PAGES __11 X 17 MAPS __LARGE MAP

COMMENTS: ____________________

CC: ____________________